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# 45th SPACE WING/PATRICK AIR FORCE BASE

# LAUNCH SITE SAFETY ASSESSMENT

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**For**

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## SECTION 1.0 EASTERN RANGE GENERAL RANGE CAPABILITIES



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## LIST OF ABBREVIATIONS, ACRONYMS & DEFINITIONS

**45 SW** – 45th Space Wing

**45 SW/RANS/DOUS** – Range Scheduling

**45 SW/LG**- 45th Logistics Group

**45 SW/MDG**- 45th Medical Group

**45 SW/OG**- 45th Operations Group

**45 and 30 SW/SE** - 45th Space Wing, Office of the Chief of Safety; see also Office of the Chief of Safety

**45 SW/SEG -** 45th Space Wing, Ground Safety

**45 SW/SEO** - 45th Space Wing, Operations Safety and Analysis

**45 SW/SEOE** - 45th Space Wing, Expendable Launch Vehicle Operations Support and Analysis

**45 SW/SEOO** - 45th Space Wing, Operations Safety and Requirements

**45 SW/SEOS** - 45th Space Wing, Space Transportation System Operations Support and Analysis

**45 SW/SES** – 45th Space Wing, Systems Safety

**45 SW/SESP** – Classified Payloads

**45 SWSPTG-** 45th Support Group

**45 SW/XPR** – 45th Space Wing, Plans & Requirements

**AF** - Air Force

**AFETR -** Air Force Eastern Test Range

**AFOSH** – Air Force Occupational Safety and Health

**AFI** - Air Force Instruction

**AGC** - Automatic Gain Control

**ALD** – Assistant Launch Director

**ANT** - Antigua Air Station

**approval** - Range Safety approval is the final approval necessary for data packages such as the Preliminary Flight Data Package, the Final Flight Data Package, the Missile System Pre-launch Safety Package, the Range Safety System Report, the Ground Operations Plan, and the Facility Safety Data Package. In addition, Range Safety approval is required for hazardous and safety critical procedures prior to the procedure being performed; however, Range Safety approval does not constitute final approval for hazardous and safety critical procedures since Range Users normally have additional approval requirements prior to the procedure being performed.

**ARIA** - Advanced Range Instrumentation Aircraft

**ARG** – Argentia

**ARTCC** – Air Route Traffic Control Center

**ASC** - Ascension Auxiliary Air Field

**AST** - Associate Administrator for Commercial Space Transportation

**ATOTS** - Advanced Transportable Optical Tracking Systems

**CATEX** - Categorical Exclusion

**CCAS** - Cape Canaveral Air Station

**CCC** - Central Computer Complex

**CCD** - Charged Coupled Device

**CCFF** – Cape Canaveral Forecast Facility

**CCRS** - Central Command Remoting System

**C/D** – Countdown Net

**CDR** – Critical Design Review

**CDS** - Command destruct System

**CFR** – Code of Federal Regulations

**CIF** - Central Integration Facility

**CMEV** - Command Message Encoder Verifier

**COLA** – Collision Avoidance

**commercial user** - a non-federal government organization that provides launch operations services

**control authority** - a single commercial user on-site director and/or manager, a full time government tenant director and/or commander, or United States Air Force squadron/detachment commander responsible for the implementation of launch complex safety requirements

**CSC** – Command System Controller

**CSO** – Complex Safety Officer

**deviation** - a designation used when a design noncompliance is known to exist prior to hardware production or an operational noncompliance is known to exist prior to beginning operations at CCAS and Vandenberg Air Force Base

**DoD** - Department of Defense

**DoDD** - Department of Defense Directive

**°** - degree, degrees

**EELV** - Evolved Expendable Launch Vehicle

**EIAP** - Environmental Impact Analysis Process

**EIS** - Environmental Impact Statement

**ELV** - Expendable Launch Vehicle

**EPC** - Environmental Protection Committee

**ER** - Eastern Range

ERDAT – Eastern Range Dispersion Assessment System

**errant launch vehicle** -a launch vehicle that, during flight, violates established flight safety criteria and/or operates erratically in a manner inconsistent with its intended flight performance. Continued flight of an errant launch vehicle may grossly deviate from planned flight, with the possibility of increasing public risk to unacceptable limits.

**EWR** – Eastern and Western Regulation

**explosives** - all ammunition, demolition material, solid rocket motors, liquid propellants, pyrotechnics, and ordnance as defined in AFM 91-201 and DoD 6055.9-STD.

**failure** - the inability of a system or system component to perform a required function within specified limits

**FCA – Flight caution Area**

**Flight Caution Area** - a Hazardous Launch Area; the controlled surface area and airspace outside the Flight Hazard Area (FHA) where individual risk from a launch vehicle malfunction during the early phase of flight exceeds $1 \times 10^{-6}$. When activated, only personnel essential to the launch operation (mission-essential) with adequate breathing protection are permitted in this area; see also Flight Hazard Area, mission-essential personnel

**FHA** – Flight Hazard Area

**Flight Hazard Area** - a Hazardous Launch Area; the controlled surface area and airspace about the launch pad and flight azimuth where individual risk from a malfunction during the early phase of flight exceeds $1 \times 10^{-5}$. Because the risk of serious injury or death from blast overpressure or debris is so significant, only mission-essential personnel in approved blast-hardened structures with adequate breathing protection are permitted in this area during launch.

**FONSI** - Finding of No Significant Impact

**FPA** – Flight Plan Approval

**flight termination action** - the transmission of thrust termination and/or destruct commands to a launched launch vehicle and/or payload

**FTS** - Flight Termination System; includes the Radio Controlled Command Destruct System, the Automatic Destruct System, and associated subsystems

**FTU** - Flight Termination Unit

**GHz** - Gigahertz

**GSE** – Ground Support Equipment

**GTO** - Geotransfer Orbit

**hangfire** - a condition that exists when the ignition signal is known to have been sent and reached an initiator but ignition of the propulsion system is not achieved

**hazard, hazardous** - equipment, systems, events, and situations with an existing or potential condition that may result in a mishap

**HF** - High Frequency

**hold** - a temporary delay in the countdown, test, or practice sequence for any reason

**holdfire** - an interruption of the ignition circuit of a launch vehicle

**HQ** - Headquarters

**HPWT** – High Performance Work Team

**IFLOT** - Intermediate Focal Length Optical Tracker

**IGOR** - Intercept Ground Optical Recorders

**IIP** – Instantaneous Impact Point

**ILL** - Impact Limit Line

**impact area** - an area surrounding an approved impact point based on the launch vehicle and/or payload dispersion characteristics

**impact limit line** - a Hazardous Launch Area; the boundary within which trajectory constraints and FTSs are used to contain an errant launch vehicle and vehicle debris. Mission-essential and Wing-essential personnel are permitted within the ILLs; with Wing Commander approval, non-essential personnel may be permitted within this area. However, the collective risk will not exceed acceptable standards for non-essential personnel; see also mission-essential personnel, non-essential personnel

**independent** - not capable of being influenced by other systems

**individual risk** - the risk to a randomly exposed individual; the probability that the individual will be a casualty

**ITL** - Integrate-Transfer-Launch

**JDMTA** - Jonathan Dickinson Missile Tracking Annex

**JLRPG** - Joint Long Range Proving Grounds

**KSC** - Kennedy Space Center

**KTM** - Kineto Tracking Mounts

**launch area** - the facility, in this case, CCAS and KSC, where launch vehicles and payloads are launched; includes any supporting sites on the Eastern Range; also known as launch head

**launch area safety** - safety requirements involving risks limited to personnel and/or property on CCAS and may be extended to KSC or VAFB; involves multiple commercial users, government tenants, or United State Air Force squadron commanders

**launch complex** - a defined area that supports launch vehicle or payload operations or storage; includes launch pads and/or associated facilities

**launch complex safety** - safety requirements involving risk that is limited to personnel and/or property located within the well defined confines of a launch complex, facility, or group of facilities; for example, within the fence line; involves risk only to those personnel and/or property under the control of the control authority for the launch complex, facility, or group of facilities

**launch head** - see launch area

**launch vehicle** - a vehicle that carries and/or delivers a payload to a desired location; this is a generic term that applies to all vehicles that may be launched from the Eastern Range, including but not limited to airplanes; all types of space launch vehicles, manned space vehicles, missiles, and rockets and their stages; probes; aerostats and balloons; drones; remotely piloted vehicles; projectiles, torpedoes and air-dropped bodies

**LCC** – Launch Commit Criteria

**LD** – Launch Director

**LDA** – Launch Decision Authority

**LDZ** – Launch Danger Zone

**lead time** - the time between the beginning of a process or project and the appearance of its results

**LRR** – Launch Readiness Review

**LWO** – Launch Weather Officer

**MARSS** - Meteorological and Range Safety System

**MIC** - meets intent certification; a noncompliance designation used to indicate that an equivalent level of safety is maintained despite not meeting the exact requirements stated in this Regulation

**MIGOR** - Mobile Intercept Ground Optical Recorders

**MILA** - Merritt Island Launch Area

**misfire** - a condition that exists when it is known that the ignition signal has been sent but did not reach an initiator and ignition of the propulsion system was not achieved

**mission-essential personnel** - those persons necessary to successfully and safely complete a hazardous or launch operation and whose absence would jeopardize the completion of the operation; includes persons required to perform emergency actions according to authorized directives, persons specifically authorized by the Wing Commander to perform scheduled activities, and person in training; the number of mission-essential personnel allowed within Safety Clearance Zones or Hazardous Launch Areas is determined by the Wing Commander and the Range User with Range Safety concurrence

**Mission Rules** - a document of agreements between the Range User and Range Director specifying, in detail, those requirements and procedures not covered by this document

**MFCO - Mission Flight Control Officer** - a United States Air Force Officer or civilian who monitors the performance of launch vehicles in flight and initiates flight termination action when required; the direct representative of the Wing Commander during the pre-launch countdown and during launch vehicle powered flight

**MOTS** - Mobile Optical Tracking System

**MSPSP** – Missile System Pre-launch Safety Package

**MSU** - Message Storage Unit

**NASA** - National Aeronautics and Space Administration

**NEPA** - National Environmental Policy Act

**nominal vehicle** - a properly performing launch vehicle whose instantaneous impact point (IIP) does not deviate from the intended IIP locus

**noncompliance** - a noticeable or marked departure from Regulation standards or procedures; includes deviations, meets intent certifications, and waivers

**non-essential personnel** - those persons not deemed mission-essential or Wing-essential; includes the general public, visitors, the media, and any persons who can be excluded from Safety Clearance Zones with no effect on the operation or parallel operations

**NORAD** – North America Defense Command

**NOTAMS** – Notices to Airmen

**OD** - Operations Directive

**Office of the Chief of Safety** - the Range office headed by the Chief of Safety; this office ensures that the Range Safety Program meets Range and Range User needs and does not impose undue or overly restrictive requirements on a program

**OPR** - Office of Primary Responsibility

**OR** - Operations Requirements

**orbital injection (insertion)** - the sequence of events in time and space, whereby a vehicle achieves a combination of velocity and position such that without additional thrust at least one orbit of the earth will be made

**OSM** – Operations Security Manager

**OST** – Operations safety Technician

**PAFB** - Patrick Air Force base

**payload** - the object(s) within a payload fairing carried or delivered by a launch vehicle to a desired location or orbit; a generic term that applies to all payloads that may be delivered to or from the Eastern Range; includes but is not limited to satellites, other spacecraft, experimental packages, bomb loads, warheads, reentry vehicles, dummy loads, cargo, and any motors attached to them in the payload fairing

**PCC** - Photo Control Console

**PCM** - Pulse Code Modulation

**PDR** – Preliminary Design Review

**PI** - Program Introduction

**PL** - public law

**positive control** - the continuous capability to ensure acceptable risk to the public is not exceeded throughout each phase of powered flight or until orbital insertion

**PRD** - Program Requirements Document

**program** - the coordinated group of tasks associated with the concept, design, manufacture, preparation, checkout, and launch of a launch vehicle and/or payload to or from, or otherwise supported by the Eastern Range and the associated ground support equipment and facilities

**PSP** - Program Support Plan

**public safety** - safety involving risks to the general public of the United States or foreign countries and/or their property

**Range** - in this document, Range refers to the Eastern Range at CCAS, KSC, PAFB, JDMTA, ANT & ASC.

**Range Contractor** - the Launch Base Support and Range Technical Services contractors and all subcontracted agencies required for operation and maintenance of the ER and similar contractors at the WR. For the purposes of this regulation, the term Range Contractor also refers to NASA and KSC contractors as applicable

**Range Safety Launch Commit Criteria** - hazardous or safety critical parameters, including, but not limited to, those associated with the launch vehicle, payload, ground support equipment, Range Safety System, hazardous area clearance requirements, and meteorological conditions that must be within defined limits to ensure that public, launch area, and launch complex safety can be maintained during a launch operation

**Range Safety Program** - a program implemented to ensure that launch and flight of launch vehicles and payloads present no greater risk to the general public than that imposed by the overflight of conventional aircraft; such a program also includes launch complex and launch area safety and protection of national resources

**Range Safety System** - the system consisting of the airborne and ground flight termination systems, airborne and ground tracking system, and the airborne and ground telemetry data transmission systems

**Range Users** - clients of the Cape Canaveral Air Station, such as the Department of Defense, non-Department of Defense US government agencies, civilian commercial companies (Launch Operators), and foreign government agencies that use Eastern Range facilities and test equipment; conduct pre-launch, launch, and impact operations;

or require on-orbit support.

**RAPCON** – Radar Approach and Control

**RASCAD** - Range Safety Control and Display

**RCO** – Range Control Officer

**RF** - Radio Frequency

**risk** - a measure that takes into consideration both the probability of occurrence and the consequence of a hazard to a population or installation. Risk is measured in the same units as the consequence such as number of injuries, fatalities, or dollar loss. For Range Safety, risk is expressed as casualty expectation or shown in a risk profile; see also collective risk and individual risk.

**risk analysis** - a study of potential risk

**ROC** – Range Operations Commander

**ROCC** - Range Operations Control Center

**ROTI** - Recording Optical Tracking Instrument

**RSA** - Range Standardization and Automation

**RSDS** - Range Safety Display System

**RSOR** - Range Safety Operating Requirements

**RTS** - Range Tracking System

**RUSSDPA** – Range User Systems Safety Data Package Approval

**Safety Clearance Zones** - restricted areas designated for day-to-day pre-launch processing and launch operations to protect the public, launch area, and launch complex personnel; these zones are established for each launch vehicle and payload at specific processing facilities, including launch complexes; includes HCA and HLA

**safety holds** - the holdfire capability, emergency voice procedures, or light indication system of each launch system used to prevent launches in the event of loss of Range Safety critical systems or violations of mandatory Range Safety launch commit criteria

**SC** - Statement of Capability

**SCO** – Surveillance Control Officer

**SDR** – System Design Review

**SELV** - Small Expendable Launch Vehicle

**SLBM** - Sea Launched Ballistic Missiles

**SLC** - Space launch Complex

**SLF** - Shuttle Landing Facility

**SMAB** - Solid Motor Assembly Building

**SMARF** - Solid Motor Assembly and Readiness Facility

**SMC** - Space & Missile Systems Center

**SMFCO** – Senior Mission Flight Control Officer

**SMILS** - Sonar Buoy Missile Locator Impact System

**space safety professional** - a safety professional who has been trained and formally certified to meet the criteria outlined in the Launch Complex Safety Training and Certification Program Document

**SPARC** - Single Point Acquisition and Radar Control

**SPF** - Space Port Florida Authority

**SRR** – System requirements Review

STA – Safety Technical Advisor

**STS** - Space Transportation System

**T-X** – The time in the launch countdown after which it has been determined by Range Safety and the Range User that it is more dangerous to hold a launch than to proceed. Electronic or verbal holds will not be initiated by Range Safety personnel following this time. Any exceptions to this policy will be formally documented.

**TIM** - Technical Interchange Meeting

**transponder** - the portion of the airborne Range tracking system that receives and decodes interrogations and generates replies to the interrogations. The transponder permits the ground instrumentation radar to furnish significantly greater precision and accuracy data at much greater distances and prevents miss-tracking of powered vehicles due to interference of exhaust plumes or spent stages

**TSO** – Telemetry Systems Officer

**UCS** - Universal Camera Sites

**UDS** - Universal Documentation System

**US** - United States

**USAF** – United States Air Force

**USCG** – United States Coast Guard

**UHF** - Ultra High Frequency

**VAFB** - Vandenberg Air Force base

**VDL** – Voice Direct Lines

**VHF** - Very High Frequency

**VIB** - Vertical Integration Building

**VP** – Vertical Plane

**VRP** - Video Remote Patch

**VWSS** – Vertical Wire Skyscreen

**waiver** - a designation used when, through an error in the manufacturing process or for other reasons, a hardware noncompliance is discovered after hardware production, or an operational noncompliance is discovered after operations have begun at the Eastern Range

**Wing Commander** - Commander of the Eastern Range in accordance with DoDD 3200.11; sometimes called Range Director, when interfacing with commercial Range Users.

**NOTE:** Currently, the 45 SW Commander is also the Range Commander and Range Director

# SECTION 1.0

## EASTERN RANGE

## GENERAL RANGE CAPABILITIES

## 1.1 GENERAL INFORMATION

### 1.1.1 Local Area and Local Population Information

Headquarters for the Eastern Range (ER) is located at Patrick Air Force Base (PAFB), Florida. PAFB is located on the East Coast of Florida on a barrier island that is separated from the mainland by estuaries and an intervening land mass, Merritt Island. See Figure 1-1. The ER supports two major launch heads located adjacent to each other approximately 21 miles north of the main base. The first of these is Cape Canaveral Air Station (CCAS) located on the northern end of the barrier island. The second, John F. Kennedy Space Center (KSC), is on the northern end of Merritt Island and immediately west of CCAS. The primary launch head, CCAS, covers 25 $mi^2$ and has a normal daytime population of approximately 7,049 persons distributed primarily in its industrial area, the Integrate-Transfer-Launch (ITL) area, and at the Range Operations Control Center (ROCC), see Figure 1-2. CCAS is bordered on it's East side by the Atlantic Ocean and on the north and west by KSC.

Immediately to the south of CCAS is Port Canaveral (see Figure 1-3) which is the center for several major cruise lines, sport and commercial fishing, restaurants, marinas, shipping, docking, warehousing, the Coast Guard Station, the Army Out-port, the Navy Wharf, and the Navy Trident (submarine) Turning Basin. The port has a working population of approximately 6000 personnel. Cruise Liners depart or arrive daily, each with 1800-2600 passengers. With other visitors to the local businesses and Jetty Park on the southeast corner of the Port, the daily transient population could easily exceed 3,000-4,000 persons.

Other major population Centers in the local area include KSC, the unincorporated area of Merritt Island, and the cities of Cape Canaveral, Titusville, Cocoa, Cocoa Beach, and Melbourne. These areas, their approximate weekday daytime population, and their size are shown in Table 1-1.

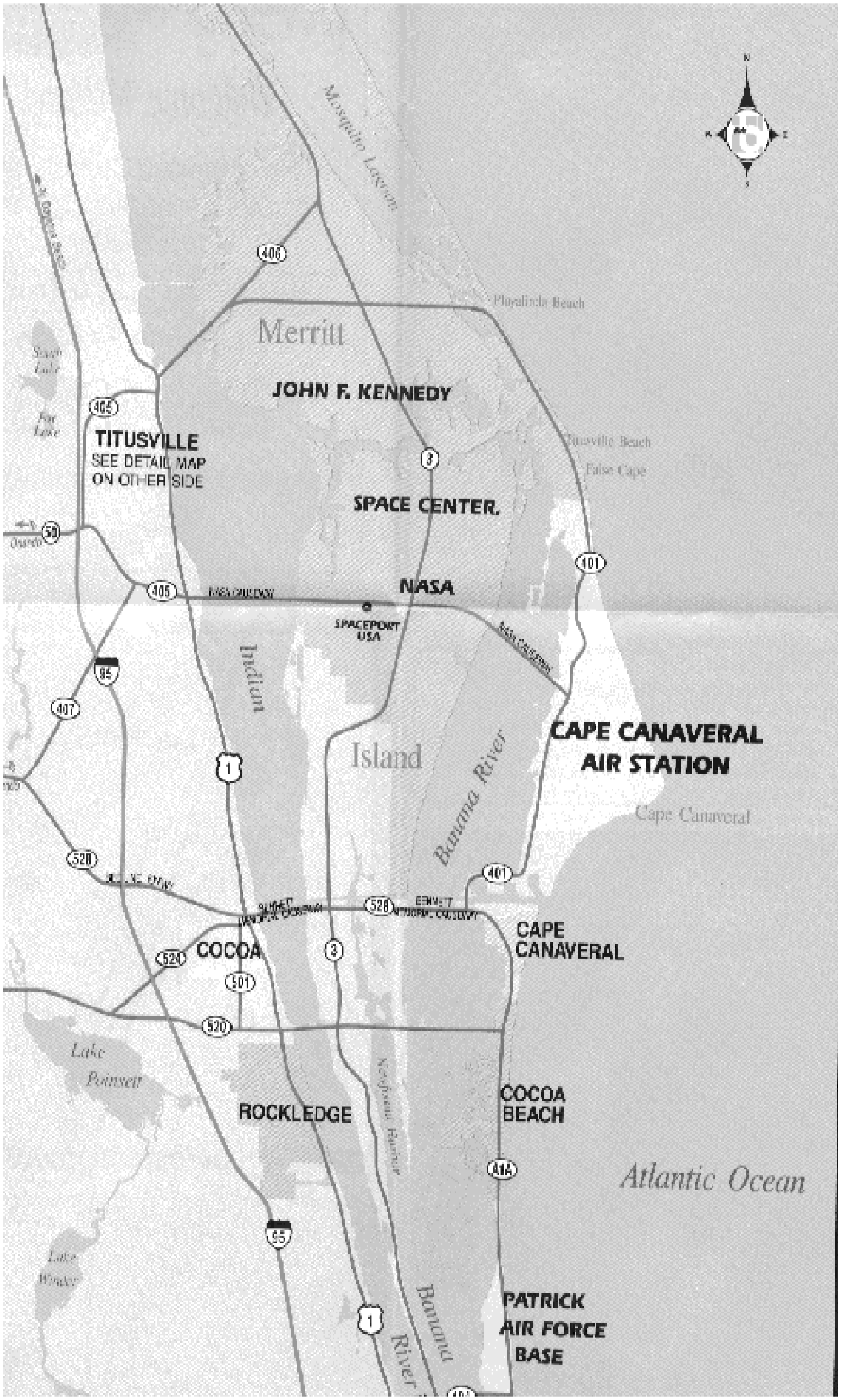


**Figure 1 - 1: CCAS and Local Area**

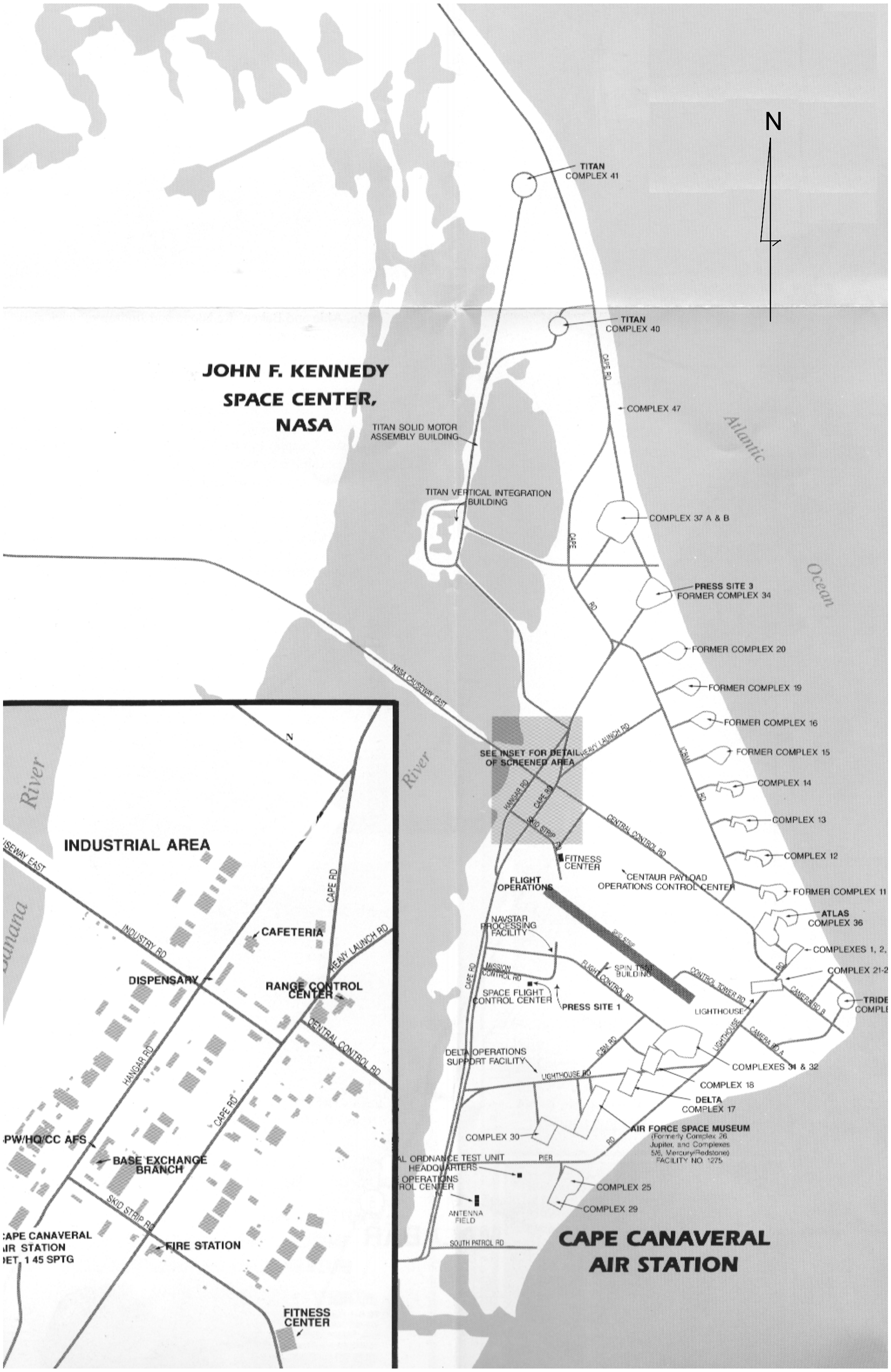


**Figure 1 - 2: Cape Canaveral Air Station**

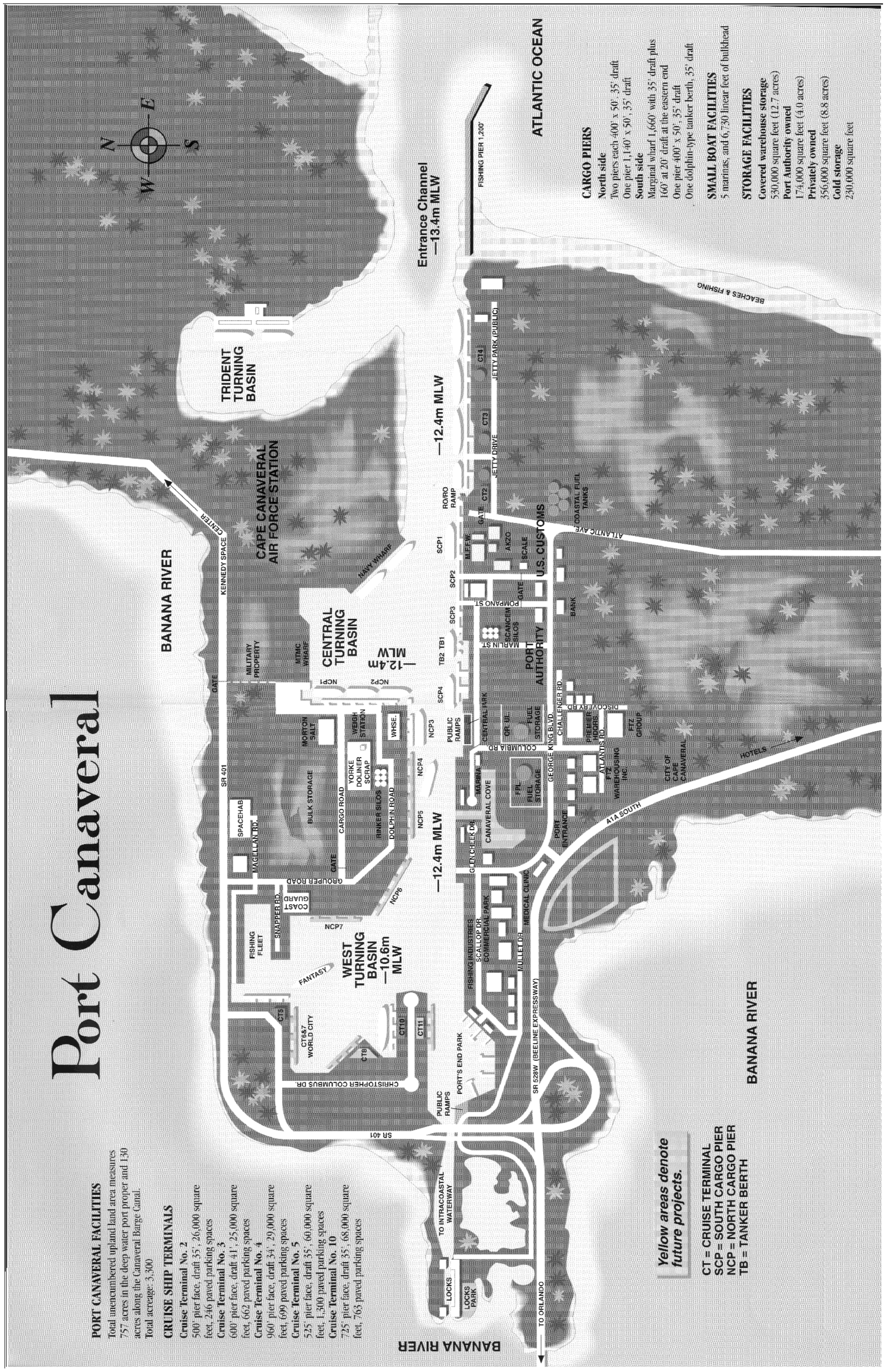


**Figure 1 - 3: Port Canaveral**

**Table 1 - 1: ER Local Population Data**

| Pop. Area | Population (Weekday Daytime) | Relative to CCAS | | |
|---|---|---|---|---|
| | | Distance (mi) | Direction | Area in $mi^2$ |
| KSC | 14,696 | 1 | W | 218.75 |
| Port Canaveral | >6,000 | Adjacent | to S | 5.2 |
| Cocoa Beach | 13,571 | 6 | S | 18.0 |
| Cocoa | 17,982 | 8 | WSW | 7.5 |
| Cape Canaveral | 8,822 | 1 | S | 1.9 |
| Merritt Island | 41,864 | 2 | WSW | 35.6 |
| Rockledge | 20,458 | 8.7 | SSW | 8.0 |
| Titusville | 42,000 | 13 | WNW | 18 |
| Melbourne | 74,489 | 24 | S | 36.0 |

### 1.1.2 Eastern Range History/General Capabilities

The Eastern Range

The Eastern Range, which extends from the East coast of Florida to the middle of the Indian Ocean, started operations October 1, 1940, as the Banana River Naval Air Station. The Range's mission was the support of antisubmarine sea-patrol planes during the WWII. It was deactivated in 1947, with the rest of the government land on the barrier island, and maintained in standby status as the Joint Long Range Proving Ground (JLRPG). Control was transferred to the Air Force (AF) and the base was reactivated in May 1950. In August of 1950, the base was renamed Patrick Air Force Base in honor of Major General Mason M. Patrick. The JLRPG became the Air Force Eastern Test Range (AFETR) and then the Eastern Test Range. Upon its transition to Space Command in November 1991, the range became the Eastern Ranges(see Figure 1-4) operated by the 45th Space Wing headquartered at Patrick Air Force Base.

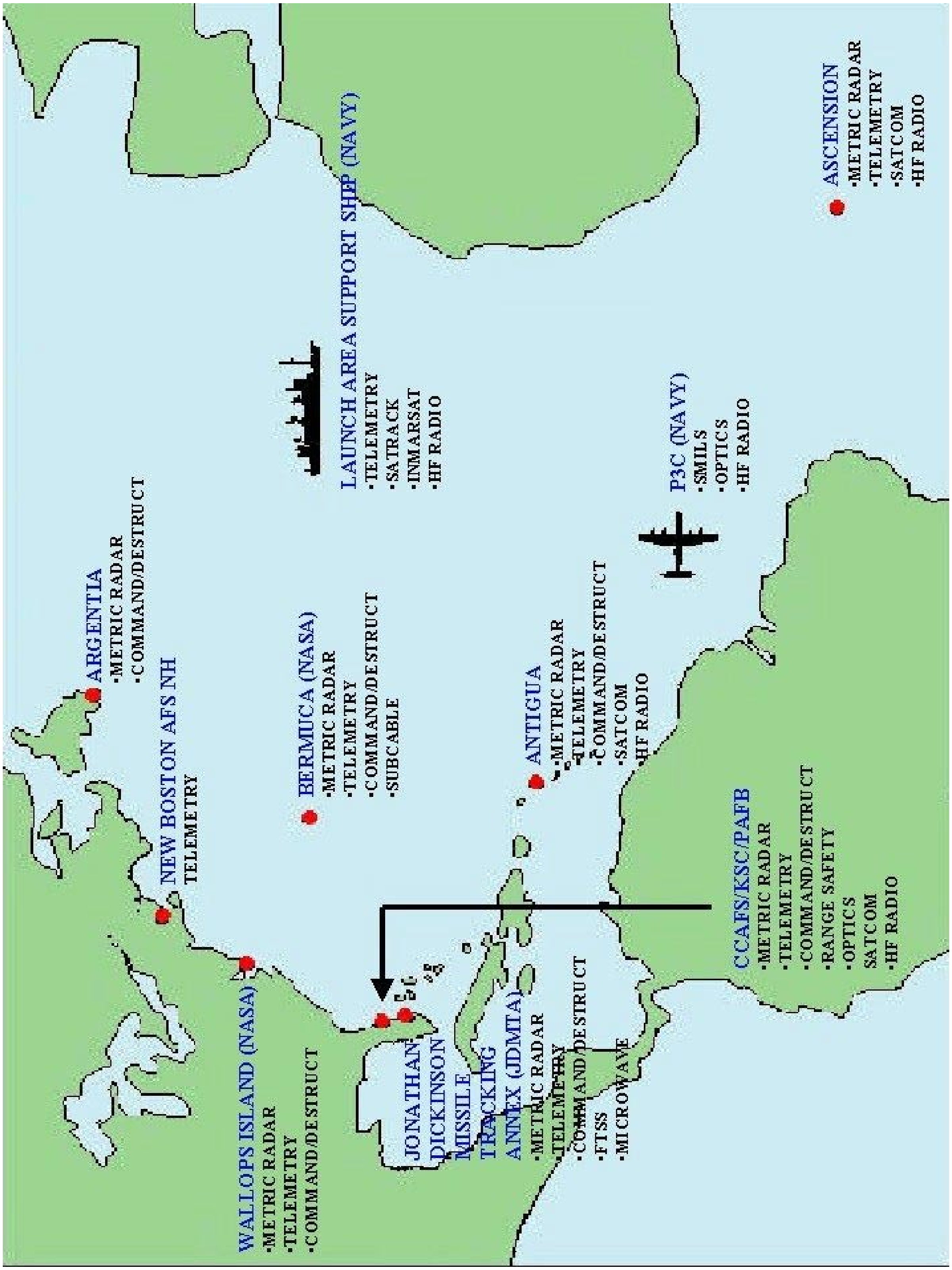


**Figure 1 - 4: Eastern Range**

The over 3295 launches from the ER have included sub-orbital (ballistic) and orbital launches. In the 50's and 60's, many of these were land and sea launched ballistic missiles and anti-aircraft missile systems. Since 1989, over 70 of these have been commercial launches. Licensed Commercial launches from the ER have included the Prospector, Delta, Delta II, Titan III, Atlas I, Atlas II, Atlas IIA, Atlas IIAS and Athena II vehicles. These vehicles and a variety of payloads have been flown for the US and foreign agencies, and including Great Britain, Japan, Germany, Indonesia, Korea and International Consortiums. All but one of the payloads were orbital missions (communications satellites). Prospector, a Castor IV vehicle, launched in 1991 was a sub-orbital micro-gravity experiment (Joust). The ER has also provided support for Commercial launches sponsored by other lead Ranges such as the Pegasus launch from the Wallops Flight Facility, Wallops Island, Virginia and the French Guiana Ariane Vehicles. Launch projections for commercial missions continue to grow and are rapidly approaching 50-60% of the ER launch schedule.

Approved launch azimuths depend on acceptable impact areas which are driven by the above land masses and associated populated areas. Normally, ER impact areas lie in the Atlantic Ocean between the azimuths of 44 degrees and 110 degrees however, with an acceptable risk analysis, launch azimuths between 37 and 114 degrees can be achieved. (see Figure 1-5). These normal launch azimuths permit orbital inclinations of approximately 28.5 degrees to 52.5 degrees. Impacts are not permitted within 200 miles of a foreign land mass by international agreement.

Eastern Range launch constraints, are based on the CCAS launch pad locations with respect to population centers both on and off the facility, as well as the U.S. coastal land masses to the north and south, the Caribbean Islands, Bermuda, the northeast coasts of South America, and Africa. In general, vehicles must be launched in an easterly direction and on an azimuth that provides protection for land masses and populated areas from nominal spent stage impacts, vehicle over-flight and other debris generated as a result of destruct actions taken.

Other limitations are mainly due to site plan quantity-distance requirements based on vehicle propellant TNT equivalencies, Flight hazard and blast danger areas that reflect vehicle performance, and consideration of impact areas of spent, separated stages. Both liquid and solid propellant vehicles are launched from the ER.

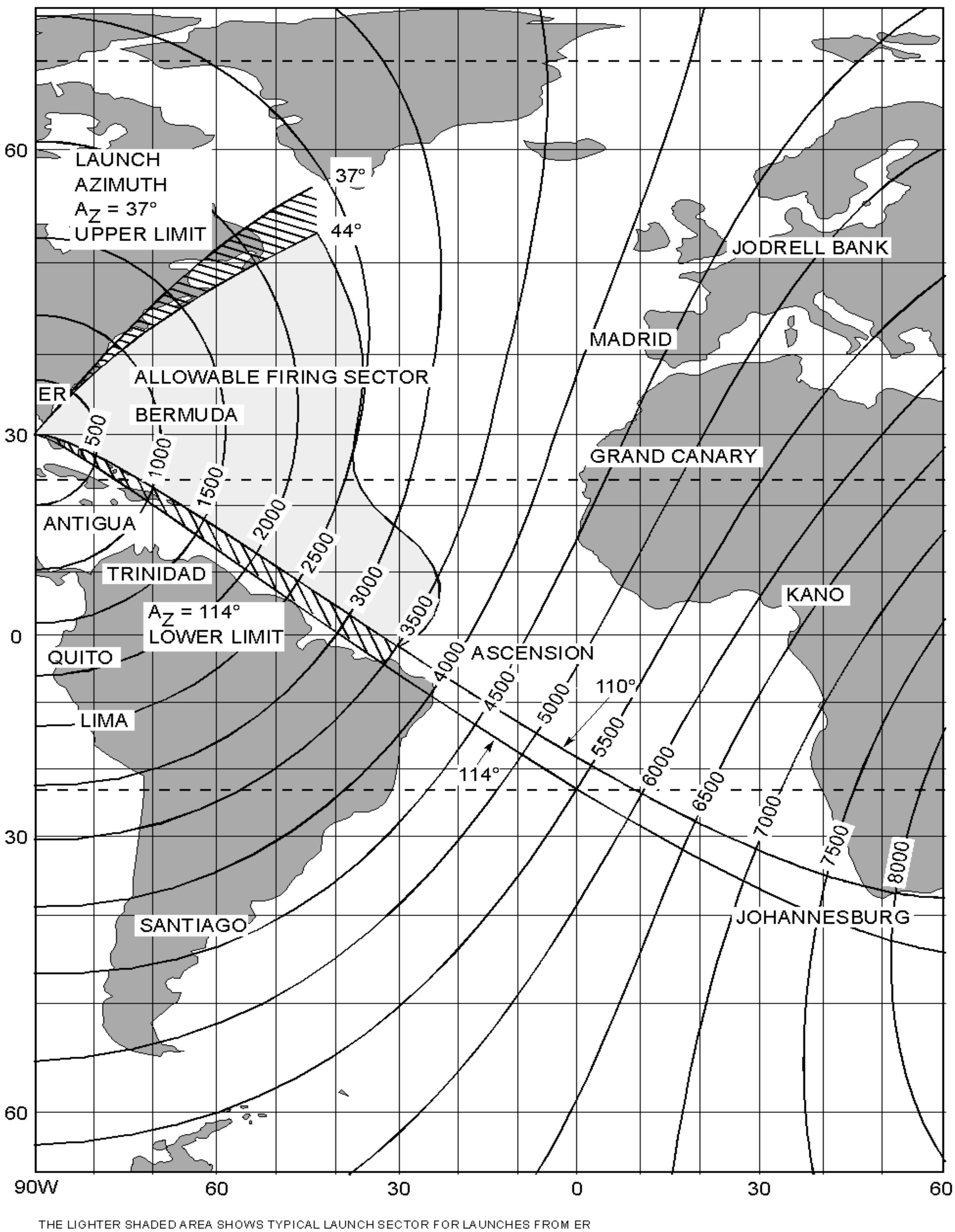


**Figure 1 - 5: Azimuth Limits**

### 1.1.3 Eastern Range Organization

As shown in Figure 1-6, the 14th Air Force falls directly under the United States Air Force (USAF) Space Command. The Commander of Space Command reports directly to the Secretary of the Air Force. The 14th Air Force Commander located at Vandenberg AFB, CA is responsible for operations conducted by the; 45th Space Wing (Patrick Air Force Base, Florida), the 30th Space Wing (Vandenberg Air Force Base, California), the 21st Space Wing (Peterson AFB, Colorado), the 50th and 73rd Space Wings (Schriever AFB, Colorado), and the 721st Space Group (Cheyenne Mountain, Colorado). The Commander 45th Space Wing is directly responsible for operations of the Eastern Range.

The 45th Space Wing Safety Office (SE) is on the wing staff (see Figure 1-7). SE's overall responsibility is to:

- Establish, direct, and manage the ER Commander's overall safety program in flying, nuclear, explosive, missile, ground/industrial, and system safety disciplines;
- Establish and direct the missile flight safety program;
- Ensure all agencies comply with the safety programs;
- Provide safety engineering, program management, and technical advice/ assistance to range users and to the Administrative Contracting Officer in evaluating contracting operations;
- Assist the Commander of the Eastern Range in preparation of the Range Safety portion of Program Support Plans, Operations Directives, and Range contracts;
- Provide technical contract management for the safety portion of the Range Technical Services (RTS) contract and the Safety Support Contract and the ordnance portion of the Launch Operations and Support Contract.
- Provide technical contract management for the safety portion of the NASA and Air Force 45$^{th}$ Space Wing Joint Base Operations Support Contract (JBOSC).

These functions are delegated to and accomplished by the 45SW/SE Sections as detailed in Section 2 of this document. The 45$^{th}$ Space Wing Group Organizational structure is as shown in Figure 1-7.

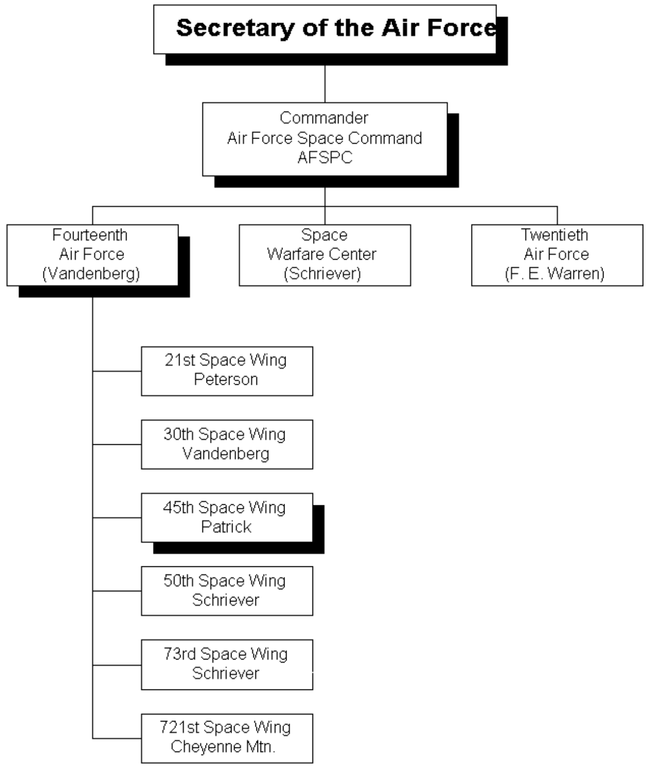


**Figure 1 - 6: Fourteenth Air Force Organization**

### 1.1.4 Eastern Range

The 45SW at PAFB and CCAS (see Figure 1.7) provides spacecraft processing, launch and tracking facilities, safety procedures, and test data to a variety of customers. These customers include commercial, foreign governments, DOD, and the National Aeronautics and Space Administration (NASA). The ER consists of a series of sites that reach as far north as Argentia Newfoundland and as far south as Ascension Auxiliary Air Field in the South Atlantic Ocean. These sites are augmented by a fleet of Advanced Range Instrumentation Aircraft (ARIA) from the 452nd Test Squadron located at Edwards AFB, California. In addition, the range uses instrumentation operated by NASA at Wallops Island, Virginia, Kennedy Space Center (KSC), Hanscom AFB, MA and the Tracking & Data Relay Satellite System (TDRSS) (see Figures 1-1 and 1-4).

Missile Flight Control Officers (MFCOs) are provided from both 45SW/SE and 45SW/RANS (45th Range Squadron) resources. Within RANS, MFCOs reside in RANS/DOO-C and RANS/DOUT (See Figure 1-8). MFCO training is provided by RANS/DOUT.

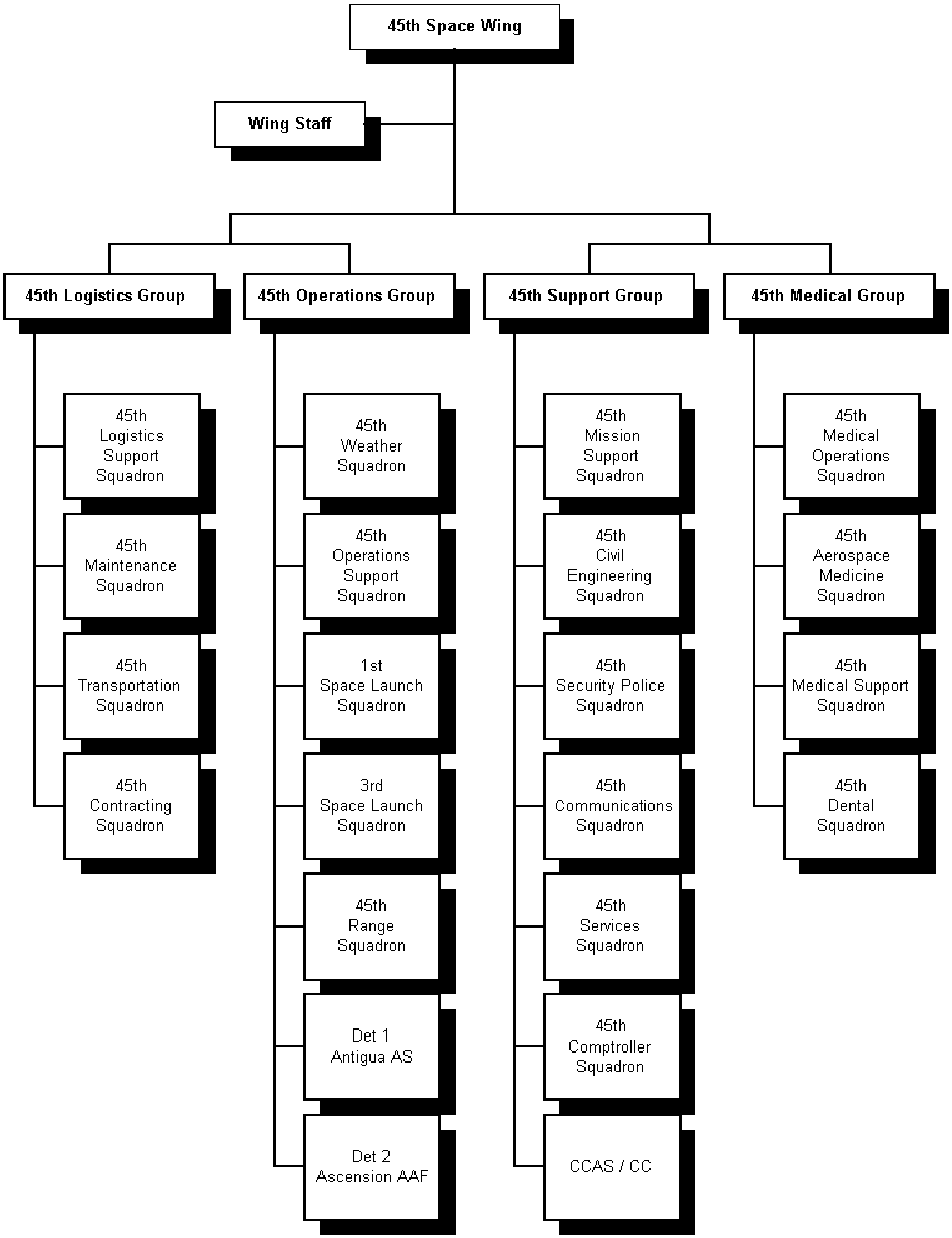


**Figure 1 - 7: 45th Space Wing Group Organization**

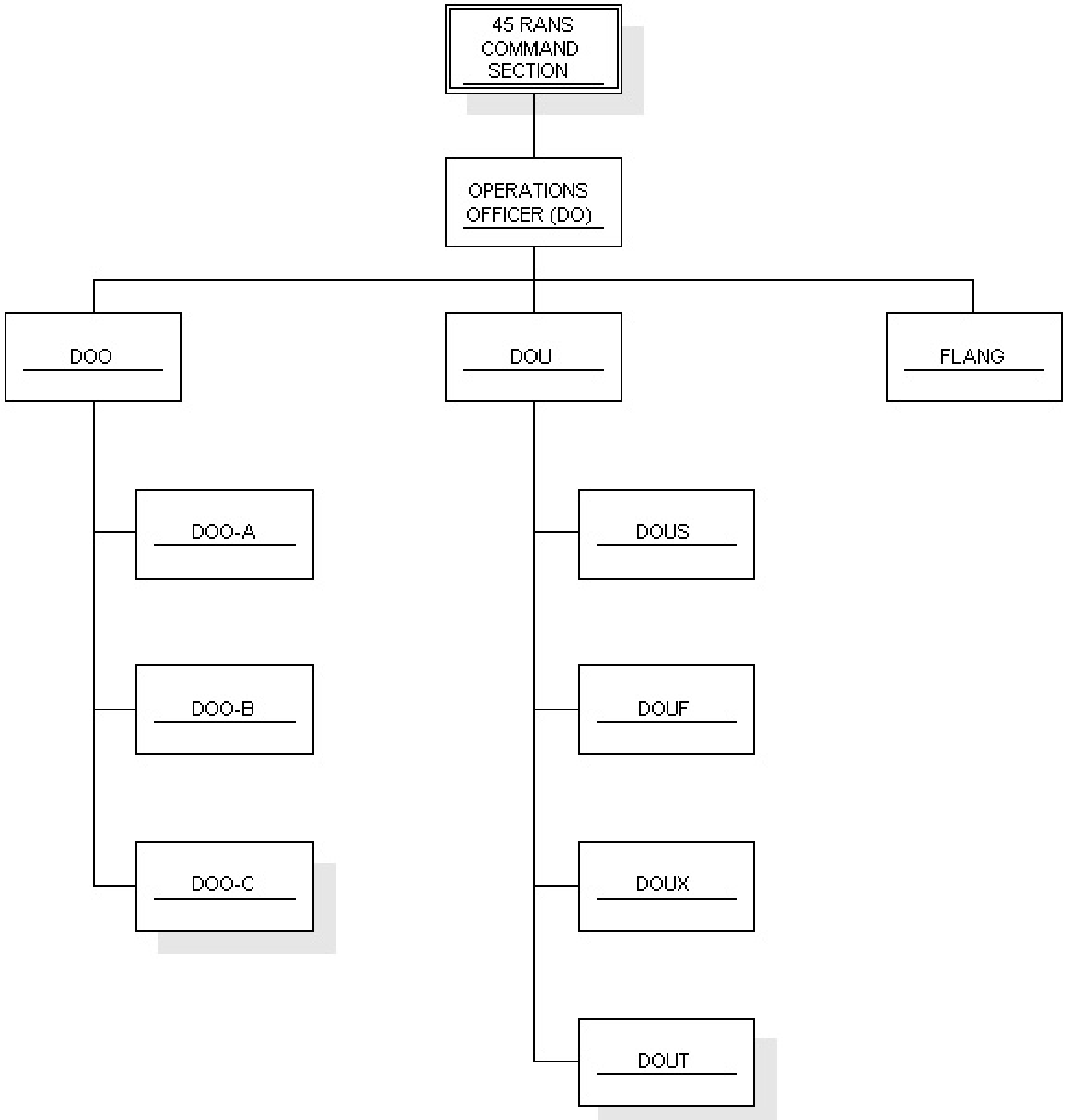


**Figure 1 - 8: 45SW/RANS (45th Range Squadron)**

### 1.1.5 The Air Force Commercial Program

The Office of the Assistant Secretary of the Air Force (Space) (SAF/SX), leads development of Air Force policy for support of commercial space activities. AFSPC's Commercial Services Branch (within AFSPC/DOPP) has management responsibility for commercial space activities.

AFSPC's Director of Combat Analysis (/DOP) has lead signature authority for the Air Force Commercialization Agreement. While the Space and Missile Systems Center (SMC), at Los Angeles Air Force Base, retains responsibility for booster production matters, they also sign Air Force Commercialization Agreements. The Wing Plans office (45SW/XPR) functions as the single point of contact for commercial space activities and is responsible for coordinating initial support arrangements.

The Air Force uses a variety of processes to arrange support for US commercial space launch operators at Air Force launch bases. Air Force Space Command (AFSPC) has institutionalized processes for the 45SW to use in arranging and providing support for commercial operators. These processes include establishing the new commercial customer, arranging use of excess capacity of Air Force launch property and services, and performing environmental impact analyses. Intermixed with these processes are the standard range documents prepared under the Universal Documentation System (UDS). Discussions of these requirements and the ER processes necessary to support the commercial user are contained within the following paragraphs.

#### 1.1.5.1 Standard Documentation:

45SW Instruction, 99-101, Mission Program Documents, states the policies, procedures, and instructions for preparing, submitting, and processing mission documents in the Universal Documentation System (UDS), the official documentation system in effect at all national ranges.

The UDS specifies 3 levels of standard documentation. Level 1 includes the Program Introduction and the Statement of Capability. This commercial user/range pair is used to initiate program support planning. Level 2 documents, the Program Requirements Document and the Program Support Plan, may be required to provide additional or more detailed program information, especially for the more complex programs (see para. 1.1.5.1.2). Level 3 documents, the Operations Requirements and the Operations Directive, are used to plan for individual operations within a program. Each document is briefly described below and the flow is outlined in Figure 1-9.

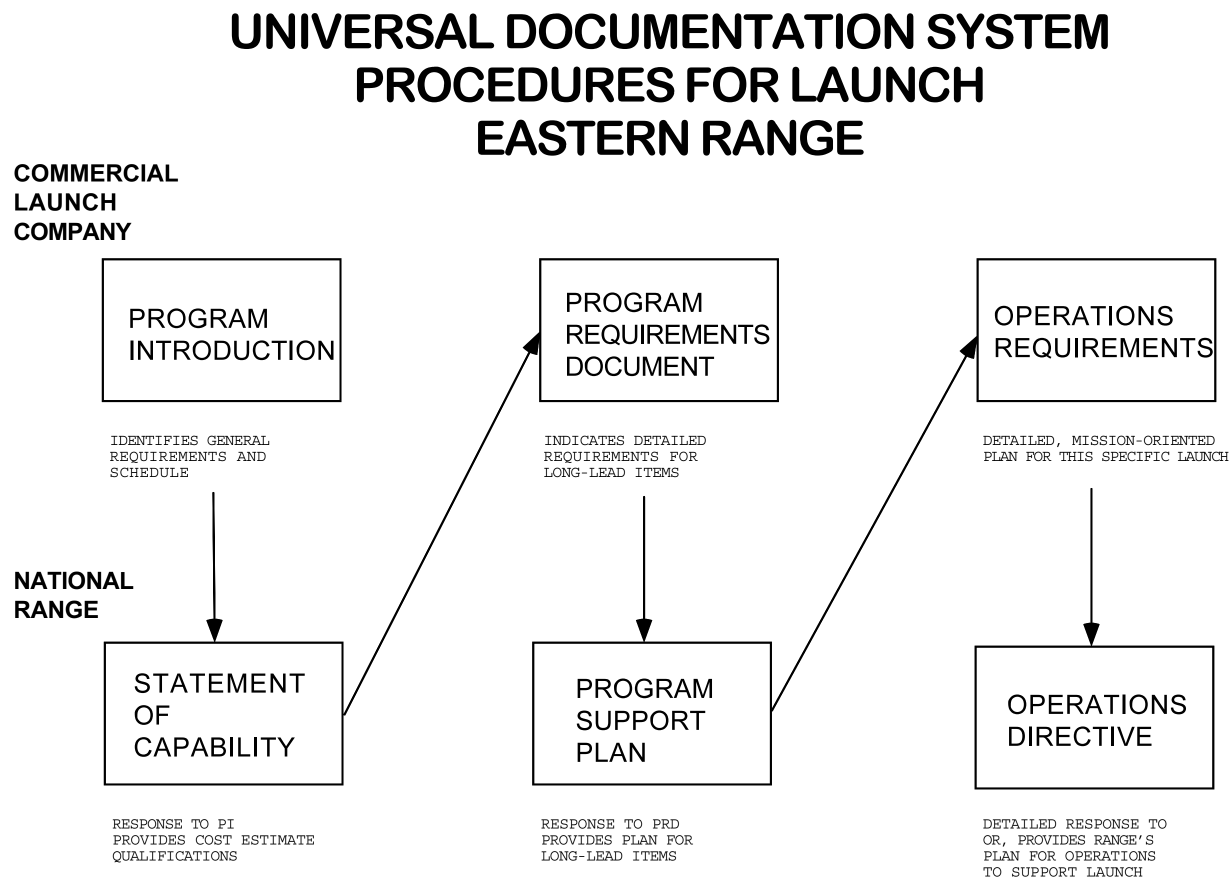


**Figure 1 - 9: Standard Document Flow**

### 1.1.5.1.1 Level 1 Documentation:

**Program Introduction** - The Program Introduction (PI) is the initial planning document submitted by a potential customer to the support agency immediately upon identification of the scope and duration of program activity. It gives a general description of their program, the launch site, trajectory, and mission requirements. The potential customer should submit the PI, using best available information, enabling the support agency to initiate resource and technical planning. This information, while sometimes fragmentary and incomplete, is of substantial value to the support agency in determining the scope of the program. For many programs, the PI is designed to eliminate further documentation except for conduct of specific tests.

**Statement of Capability** - The Statement of Capability (SC) is the support agency's response to the PI. Operations Safety and Analysis (SEO) is normally the Office of Primary Responsibility (OPR) for SE's response and consolidates all of the SE responses for the Chief of Safety's signature. The SEO input, along with the inputs from other ER staff agencies, is included in the SC. When signed, the SC is evidence that a program has been accepted for support by the support agency; subject to approval by higher headquarters, when applicable. Support conditions, qualifications, and resources, or other considerations, are initially identified by this document and serve as a baseline reference to subsequent acceptance and commitment by the support agency. The PI and the SC complement each other in establishing the scope of the program support activity.

NOTE: SEO should make the decision regarding the need for a Flight Termination System (FTS) during the preliminary design review. This may precede the PI document. Coordination between the range user and SEO during this time frame on the need for a FTS may be achieved by other correspondence and/or personal contacts/meetings. The SC must contain the SEO position on the need for a FTS.

#### 1.1.5.1.2 Level 2 Documentation:

**Program Requirements Document -** The Program Requirements Document (PRD) is a detailed full-program planning document normally required for complex or long lead-time programs. It contains the requirements for support desired from the support agency and may contain supplemental information when needed for clarity of purpose. It should include the specific trajectory of the planned mission. The need for a PRD will be determined during the analysis of the PI or during early planning meetings and will be so stated in the SC. A PRD is submitted to assure that support capability will be available during the time period required by the user organization. Requirements should be submitted immediately upon identification. The user should not delay submittal of the PRD because of incomplete knowledge of support requirements.

**Program Support Plan -** The Program Support Plan (PSP) is a response to the requirements presented in the PRD and is prepared by the responsible support agency. This response indicates those requirements that can be met from existing resources, those that can only be met through programming new resources or through alternatives, and those which cannot be met by the support agency. The PSP is prepared on a series of forms similar to the PRD and retains the same outline and format. It is maintained current with revised program requirements by corresponding revision for the duration of the program.

#### 1.1.5.1.3 Level 3 Documentation:

**Operations Requirements -** The Operations Requirements (OR) document is a mission oriented document that describes in detail the requirements for each mission, special test, or series of tests. The OR is prepared by the range user. The PRD and OR must be complete documents capable of standing alone. The OR must not reflect new requirements not previously stated in the PI and/or PRD.

NOTE: 45SW/SE prepares a Range Safety Operations Requirements (RSOR) document to detail mission-specific requirements. The RSOR serves as a tailoring mechanism for EWR 127-1, Chapter 7 (Flight Control Section) for a class of vehicles

(Delta II, Atlas II, Atlas IIAS and etc.). The RSOR is used as an input to the Operations Requirements and Operations Directive documents. RSOR's are prepared for all launch vehicles, including meteorological rockets.

**Operations Directive** - The Operations Directive (OD) is the support agency's response to the OR and is a detailed plan for implementation of support functions for a specific operation or series of operations. SEO reviews the OR and provides an input to the OD to be included with inputs from SES and all 45SW units. The OD is the official range publication that mobilizes the resources available to the ER. The purpose of the OD is to:

- Form an official reply to the OR,
- Establish a basis for scheduling the mission,
- Commit range support,
- Provide support operating instructions.

### 1.1.5.2 Establishing the New Commercial Customer

The following paragraphs explain the processes by which the new commercial customer is introduced to the procedures, documentation, and requirements by which the range operates:

#### 1.1.5.2.1 New User Introduction Process:

The process by which these documents and the associated agreements meld to form a cohesive commercial program begins when the potential commercial Eastern Range user makes initial contact with FAA's Associate Administrator for Commercial Space Transportation (AST) and the ER Wing Plans Office, 45SW/XPR. The Wing Plans office will participate in general discussions with the commercial operator, focusing on the feasibility of supporting the proposed new program, within launch base constraints.

#### 1.1.5.2.2 Mini Agreement:

Once the proposed new program is sufficiently defined, and the amount of government effort required to continue a dialogue with the prospective new user is justified, then the Wing Plans office recommends that the Wing Commander sign the Interim (Mini) Agreement with the commercial operator. The Mini Agreement defines the terms and conditions for initial planning support.

#### 1.1.5.2.3 Initial Support Documentation:

With the Mini Agreement in place, the Wing Plans office will work closely with the commercial operator to produce a Program Introduction, documenting support requirements for the new program. In response, Wing Plans will produce a Statement of Capability (SC) outlining government support. The SC does not represent a government support commitment until it becomes part of the signed Air Force Commercialization Agreement, and the environmental impact analysis process is completed.

#### 1.1.5.2.4 Air Force Commercialization Agreement:

This Agreement represents the government's commitment to provide support for the commercial program, subject to satisfactory completion of the environmental impact analysis process. The commercial operator sends a written request for AFSPC/DOP to execute the Air Force Commercialization Agreement with them. AFSPC/DOPP will obtain a complete Annex from the 45SW (signed by the Wing commander). After coordination through the HQ AFSPC staff, AFSPC/DOPP will return a copy of the Agreement to the commercial operator, signed by AFSPC/DOP and SMC/CL. The Air Force has to issue a lease or license for use of the requested property and also requires an EBS. After the commercial operator signs the Agreement, and obtains a FAA/AST license for launch processing, the launch provider is in the position to begin launch operations and request and obtain government support under the terms and conditions of the Agreement.

The Commercial Space Operations Support Agreement (CSOSA) has been signed by both Air Force and Industry officials and sets the stage for implementation at both the Eastern and Western Ranges. The agreements establish a framework by which the military will furnish government owned space launch facilities and related property to commercial users.

### 1.1.5.3 Using Excess Capacity of Government Launch Property:

This section contains the process required to initiate facility siting, the requirements for leasing Air Force real estate, and the Environmental Impact procedure that is required.

#### 1.1.5.3.1 Facility Siting Process:

In parallel with the Environmental Impact Analysis Process (1.1.5.3.3), the commercial launch operator should initiate the facility siting process through the Wing Plans office to 45$^{th}$ CES/CE. This process consists of two sub-processes, initiated by a request letter from the commercial operator to the Wing commander. The sub-processes consist of: (1) the explosive safety siting approval process that accounts for quantity-distance standoff requirements for explosive storage and launch facilities, as defined in DoD 6055.9-STD and Air Force Manual 91-201, and (2) the comprehensive planning process, based on land use plans and constraints documented in the CCAS General Plan. The Wing Plans office monitors progress and attends the Wing Facilities Board meetings and acts as the commercial operator's advocate when the Board addresses the commercial operator's site plan request.

#### 1.1.5.3.2 Lease Requirements and Process:

Air Force Instruction 32-9003 "Granting Temporary Use of Real Property" requires non-Air Force users of real estate at Air Force bases, where new facilities are to be constructed, to execute a lease for use of the real estate. Approval authority for leases exceeding five years or $200,000 rent per year rests with the Deputy Assistant Secretary of the Air Force/Installations (SAF/MII). Following SAF/MII approval, authority for negotiating, processing, executing, and administering leases is delegated to AFSPC. Below the $200,000 amount, authority is delegated to the Wing. Leases and Licenses require an Environmental Baseline Survey (EBS) and a Commercial Space Operations Support Agreement (CSOSA), ref. Section 1.1.5.2.4.

#### 1.1.5.3.3 The Environmental Impact Analysis Process:

The President's National Space Policy establishes that commercial space activities at federal launch facilities comply with the National Environmental Policy Act (Public Law 91-190, NEPA). Commercial operators must complete the Environmental Impact Analysis Process (EIAP) before the Air Force can commit support to their programs through the Air Force Commercialization Agreement. The Mini Agreement allows the Air Force to provide planning support until the EIAP is complete. "HQ AFSPC Environmental Protection Committee (EPC) Guidance on Commercial Space Activity EIAP" (October 1991) explains the process for completing the EIAP and is detailed in AF 32-7061.

- **Air Force Form 8133:** Request for Environmental Impact Analysis: This document forms the basis for the decision on what level of environmental documentation will be required for the proposed program (i.e., CATEX, Environmental Assessment, or Environmental Impact Statement).
- **Categorical Exclusion:** According to the President's Council on Environmental Quality regulation 1508.2, "a categorical exclusion (CATEX) means a category of actions which individually or cumulatively do not have a significant effect on the human environment." The Air Force list of excluded categories appears as Attachment 7 Air Force Instruction (AFI) 32-0761 and previously assessed actions qualify for a CATEX. Examples of programs in this category include those covered by the "Programmatic Environmental Assessment of Commercial Expendable Launch Vehicle Programs," published by the Federal Aviation Administration's Associate Administrator for Commercial Space Transportation (FAA/AST) in February 1986. The scope of this document is limited to privatized versions of government boosters using the same facilities and flying the same trajectories as previously-approved government programs.

- **Environmental Assessment:** For new programs, an Environmental Assessment (EA) may be sufficient for environmental approval, if it justifies a Finding of No Significant Impact (FONSI). For commercial programs using Air Force assets, 45$^{th}$ CES/CEV Environmental Planning Flight selects and manages a contractor to prepare the EA and FONSI. The review process includes coordination among the environmental office at the launch base and local, state, and federal regulatory agencies. The FONSI is executed by the AFSPC decision maker. Depending on the scope of the program and the regulatory agencies involved, the EA/FONSI process typically requires six to twelve months.
- **Environmental Impact Statement**: An AF 813 must be submitted and analyzed to determine what level of environmental documentation is required. The review process includes coordination within the Air Force, a series of public scoping meetings and hearings to address any controversial issues, and interface among the environmental offices at the launch base and local, state, and federal regulatory agencies. A Secretary of the Air Force decision maker will execute the Record of Decision. Depending on the scope of the program and the regulatory agencies involved, this process typically requires twelve to thirty- six months.
- **Permits and Additional Studies:** Depending on the scope of the program, in addition to the EA or EIS, reports and permits for issues like emissions, storm waters, waste waters and hazardous waste may be required by regulatory agencies external to the Air Force. The Range Environmental office 45CES/CEV may assist the commercial operator with preparation of these documents. The commercial operator coordinates all permit applications through the Range Environmental office 45CES/CEV. When permits for commercial activities are issued, some may be to the Air Force and some may be to the commercial operator. All permits must be compiled and held by the commercial operator.

#### 1.1.5.4 Summary:

The Air Force's Commercial Program has evolved to provide necessary launch support and services that are not readily available in the commercial realm. Access to these services begins with initial contact by the commercial operator with the FAA/AST and the 45SW Plans office. The process of establishing the new commercial customer is intertwined with the development of standard (UDS) documentation, the commercial license process, and ER/Customer agreements, as well as operations siting, leasing, and environmental impact assessment.

## 1.2 RANGE DESCRIPTION

As stated previously, the Eastern Range (ER) originates at the Cape Canaveral Air Station (CCAS) on the upper end of the barrier reef making up Florida's mid-east coast, and extends through the Atlantic Ocean, across Africa, and into the middle of the Indian Ocean (see Figure 1-4). The launch complexes and major support facilities are located on CCAS (see Figure 1-10). The principal Cape facilities and launch sites are used to store, process (assemble), checkout, and launch solid and liquid fueled vehicles that carry payloads into sub-orbital low earth and geo-synchronous/geo-stationary orbital trajectories.

### 1.2.1 Facilities and Instrumentation

The Cape's boundaries encompass complete assembly and launch facilities for ballistic missiles, space-launch vehicles and satellites, and storage and dispensing stations for fuels and oxidizers. Other types of complexes and facilities located at CCAS include blockhouses, booster preparation and payload check-out buildings, dynamic balance equipment, a timing/communications facility, wind measuring devices, communications and control instrumentation, television and optical tracking stations, surveillance and tracking radar units, and other supporting facilities (over 1600 facilities in all). Active launch sites include Space Launch Complexes 40 and 41 and part of the Integrate, Transfer and Launch Facility where all preparations and launch of the Titan IV and commercial Titan are conducted. Complex 41 is currently under modification in support of the proposed Evolved Expendable Launch Vehicle EELV LMA Common Core Booster program. Department of Defense satellites also are processed here in the Satellite Processing and Integration Facility. Global Positioning System satellites and Delta vehicles are processed at the Cape and launched from Space Launch Complexes 17A and 17B. Space Launch Complex 20 is used for sub-orbital launches and is currently under review to conduct space vehicle operations as proposed by the Spaceport Florida Authority The Atlas is launched from Space Launch Complexes 36A and 36B. Space Launch Complex 37 is under going modification to support the proposed Evolved Expendable Launch Vehicle (EELV) Boeing Delta IV program. Launch Complex 46 has been converted to support launches for the Athena class space vehicles in agreements with the Air Force and the Navy. Weather rockets are launched from the Meteorological Rocket Launch Facility at Launch Complex 47. Acreage is available for future construction to support launch of alternate concept vehicles (hybrid propulsion systems). Because of over-flight restrictions and facility siting requirements, new construction could restrict launch azimuth limits.

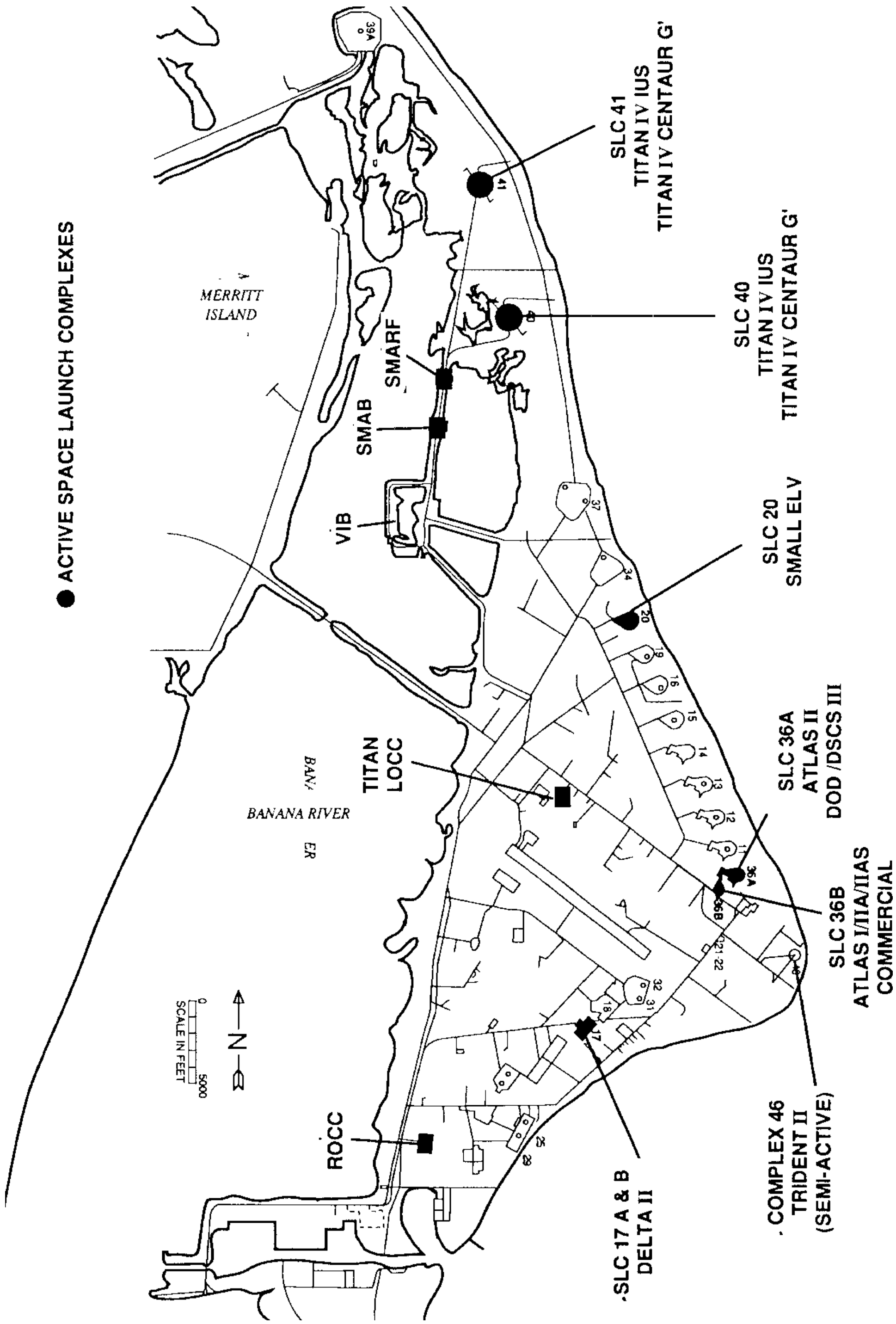


**Figure 1 - 10: CCAS**

### 1.2.2 Local and Off-Range Instrumentation

This section identifies and provides a brief overview of the local and off-site locations for radar, telemetry and command systems from Argentia to Ascension.

#### 1.2.2.1 Argentia Newfoundland

Argentia is located on the south-central portion of the 43,359 square mile island of Newfoundland that is the eastern portion of the Canadian province of Newfoundland (see Figure 1-4). The ER has a mobile C-band radar (MCBR 53.17) and command systems located on the grounds of the decommissioned Argentia US Navy Facility (NAVFAC) to support high inclination launches. The command site has two transmitters and two antennas. One antenna is an EMP the other an ANTLAB and both have an 18° beam-width. These systems are manned on an as needed basis. Communications is via leased land-line circuits on an operation by operation basis.

The telemetry systems at Argentia do not have a Telemetry Range Safety Buffer (TRSB) component and therefore are not used for Range safety.

#### 1.2.2.2 New Boston AFS, NH

Telemetry assets located at New Boston AFS are used to provide launch support for selected missions conducted from the Eastern Range. Receivers for the Tracking & Data Relay Satellite System (TDRSS) network also located at New Boston AFS are used in support of missions for TM relay for the Centaur upper stage.

#### 1.2.2.3 Wallops Island VA

Wallops Island is the location of Wallops Flight Facility, NASA's Launch site on Virginia's outer bank. The ER uses three NASA-operated radar tracking systems; an AN/FPQ-6 and two AN/FPS-16s at Wallops Island, Virginia. The radars are auto-track systems that can be fed into the Single Point Radar and Acquisition Control (SPARC) system at CCAS. Wallops command site hosts two ANTLAB steerable antennas, each antenna has a 20° beam-width.

#### 1.2.2.4 Cape Canaveral Air Station

Cape Canaveral Air Station (CCAS) is the launch head for the ER. CCAS has active launch complexes for Titan, Delta, Atlas, and small expendable launch vehicles (SELV's). In addition, the ER supports Submarine Launched Ballistic Missiles (SLBM) from designated locations in the North Atlantic. There are more than 20 active and abandoned launch complexes spread along the CCAS Atlantic coastline (see Figure 1-10). The Cape also has facilities for storing rocket motors, hazardous propellants, and liquid hydrogen, oxygen, and nitrogen, and facilities for assembling and testing most missile and payload components. The Industrial Area, a large service complex located on the center west side of CCAS adjacent to the Indian River, includes a dispensary, cafeteria, fire station, fitness center, and offices for military and contractor personnel supporting the various launch efforts at the Cape. Additional mission support comes from Range Weather Operations. This unit launches balloons and weather rockets to gather atmospheric data critical to launch events. Weather Operation's personnel also provide standard meteorological support for all units requiring their assistance. CCAS instrumentation includes radar, command sites, camera and optical sites, and an antenna farm for UHF, VHF, and HF radio communications. Range communications transmitters are located at the Malabar Transmitter Annex in Palm Bay, Florida. The radar site at Patrick Air Force Base and the Recording Optical Tracking Instrument (ROTI) at Melbourne Beach (30 miles south of the Cape) are part of the instrumentation support provided by the Cape.

The ER radar network provides:

- Real-time target position
- Trajectory and signature data
- Aircraft vectoring

All tracking radar systems used by the ER are capable of beacon and skin (echo) tracking. PAFB's AN/FPQ-14 (0.14) and Ascension's AN/TPQ-18 (12.18) are capable of tracking in both vertical and circular polarization modes. While, Ascension's AN/FPQ-15 (12.15) is capable of tracking in either right-hand or left-hand circular polarization modes, and the remaining ER radar tracking systems in the linear polarization tracking mode.

In addition, the AN/FPQ-14's and the two Ascension radars have on-axis tracking capabilities. This capability permits the radar antennas to be computer driven using data from a predetermined orbit-generator program.

Other ER radars, such as the AN/FPS 16 (1.16) and the AN/MPS-39 Multiple Object Tracking Radar (MOTR) (1.39) operate in auto-track mode and respond directly to radio frequency (RF) off-axis antenna drive errors.

Operational control and coordination of the radar resources is provided by the Single Point Acquisition and Radar Control (SPARC) System located at Cape Canaveral Air Station. The SPARC System enables the range radar controller to control on-range and some off-range systems such as those at Wallops Island, Virginia. In addition to controlling the designation data, the controller uses the SPARC system to monitor track and mode status of all ER radar systems.

The ER also uses S-band and X-band surveillance radar systems for Range Safety aircraft and ship control.

The range uses tracking mounts and tracking telescopes for optical track and engineering sequential film coverage. Non-metric Intermediate Focal Length Optical Tracker (IFLOT), Mobile Optical Tracking System (MOTS), and Kineto Tracking Mounts (KTM) are currently used for both engineering sequential and documentary optics.

The range has numerous motion picture and still cameras available for engineering sequential and documentary photography. Video cameras, both vidicon and CCD-based, and video recorders are also available. The non-metric trackers mentioned above are capable of being configured with any combination of the sensors mentioned above and various lens configurations.

ER mobile photo optical systems include Contraves and Advanced Transportable Optical Tracking Systems. The fixed photo optical systems include the Recording Optical Tracing Instrument (ROTI) at Melbourne Beach, FL, the Distant Object Altitude Measurement System DOAMS at Cocoa Beach, FL and the Intercept Ground Optical Recorder (IGOR) at PAFB.

The ER land-based telemetry facilities consist of two mainland and two downrange stations. Telemetry systems are installed at: KSC Tel-4 (Station 19), JDMTA (Station 28), Antigua (Station 91), Ascension (Station 12), and New Boston AFS, NH.

Operational control of the ER communications is exercised by the communication control centers at each major station. These centers allocate, monitor, and maintain transmission quality of all on-base and off-base circuits and technical operations nets for each respective station.

The ER uses an extensive communications network consisting of communication satellites, microwave links, high frequency (HF) radio, and various landline links to connect the sites and stations of the range with each other and the world (See Figure 1-11). This network provides the flexibility and reliability necessary to conduct the various operations supported by the range. In addition, the range receives mission support communications services from, or provides to, other test agencies such as NASA, U.S. Navy, and the 4950th Test Wing (ARIA). The range also provides non-mission communication services on both a temporary and a continuing basis to the US Army, US Navy, other Air Force agencies, NASA, US State Department, other US Government agencies, and certain commercial carriers.

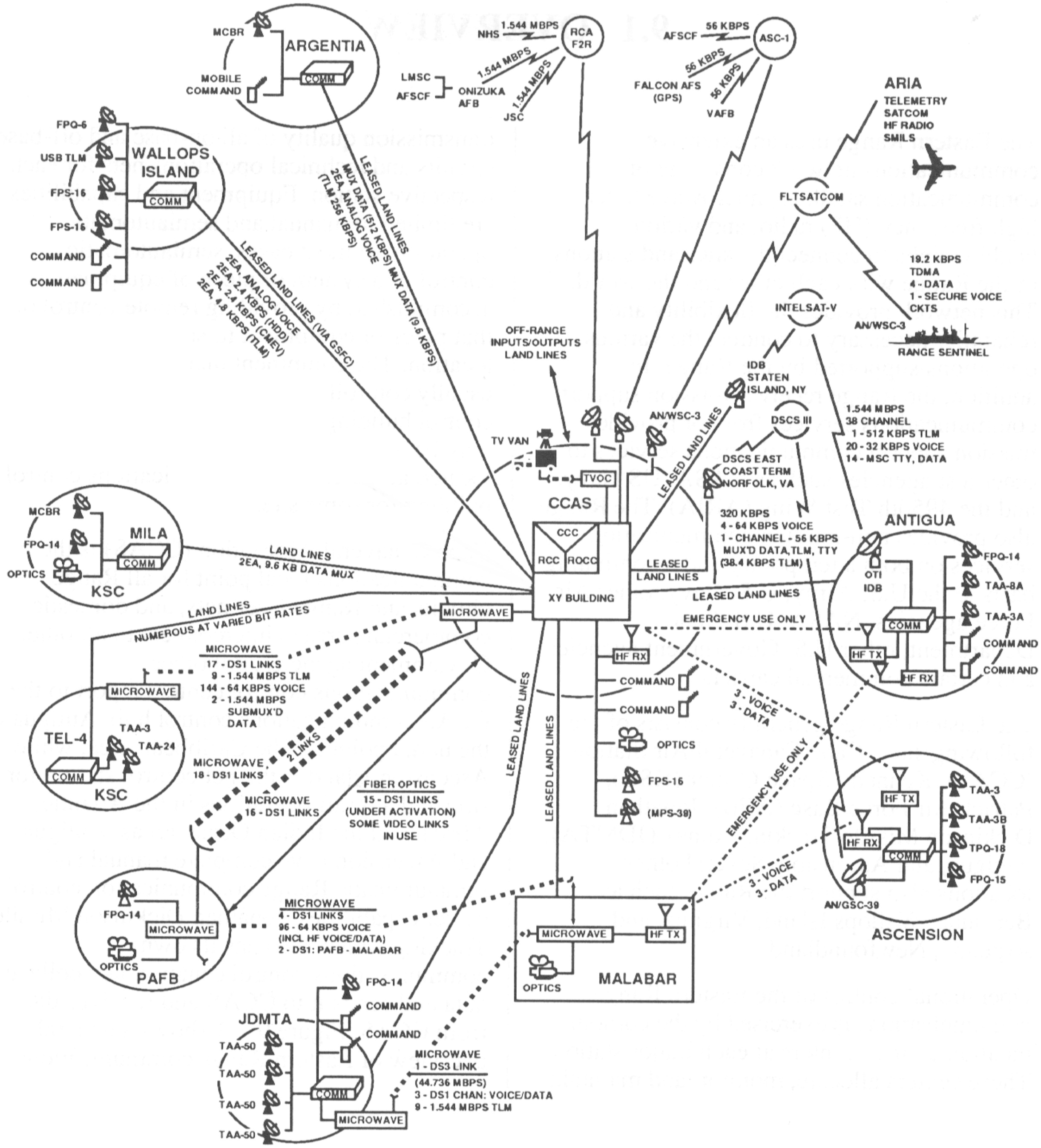


**Figure 1 - 11: ER Communications Network**

CCAS is the communications focal point for all range circuits and range user nets, and domestic commercial carriers interconnect to all other Government agencies. All other communications control centers report to the CCAS communications control hub. Antigua is the nodal point for the Caribbean area, while Ascension Island is the net control station for ship and aircraft operations in the Atlantic, Africa, and the Indian Ocean areas. Antigua and Ascension have complete manual and semiautomatic range communication control center capabilities. Jonathan Dickinson Missile Tracking Annex also has its own communications control center which collects data and sends it to CCAS and receives data from CCAS.

The purpose of the Command Destruct System (CDS) is to transmit encoded commands to missiles and spacecraft in flight. The CDS is used to provide Range and Public Safety protection on all launches on the ER to prevent errant missiles from endangering persons or property on and adjacent to the range. The CDS consists of a network of UHF radio transmitters located at CCAS, JDMTA, Antigua, and Argentia, Newfoundland. These sites are linked to the Central Command Remoting System (CCRS) located in the CCAS Range Operations Control Center (ROCC). Mission Flight Control Officers (MFCO) evaluate the real-time data via the Range Safety Display System (RSDS) to determine if the vehicle is within the flight safety limits or if it is necessary to transmit arm and/or destruct commands to terminate the flight of errant vehicles. CCAS's command site has two transmitters and four antennas. The antennas include three CANOGA steerables each with an 18° beam-width and one MELPAR omni-directional. All four antennas can support high or low power output from the transmitters.

Range user applications of the CDS include the transmission of commands such as safing the FTS and engine cut-off, as well as vehicle control messages such as payload deployment.

For northerly launch azimuths, the NASA Wallops Island radar, telemetry, and command systems are used by Range Safety when coverage from these stations is needed. In addition, the Argentia, Newfoundland site command and radar systems can be used for range safety support as required.

MFCO-generated commands are sent through the CCRS to a remote transmitting station (CCAS, JDMTA, Antigua, Wallops Island, or Argentia) and then to the in-flight vehicle. The modulated commands monitored at the transmitting antenna are decoded, checked for accuracy, and relayed back to the MFCO to confirm the transmission. Command transmissions are recorded for post-flight evaluation. EWR127-1 requires that the Automatic Gain Control (AGC) from the vehicle command receiver is reported to the MFCO via telemetry for assurance that the command receivers on the vehicle are operating.

A (CCRS) is used to monitor the status of the command transmitters and select the optimum transmitter, based on vehicle present position and site bias, that will radiate an adequate carrier signal to the launch vehicle. Remote control with the capability of enabling and disabling remote station command capability of the command system transmitters is required. Manual control of the CCRS is required to backup the automatic system.

Flight Termination Units (FTU) are located at each MFCO console position. The FTU switches are programmable for Arm, Destruct, Safe, and other, optional commands that may be required for a mission. Switches having no functions programmed for a launch are disabled.

The CCRS equipment consists of the Command Message Encoder Verifiers (CMEVs), the Command System Controller (CSC) console, the Range Safety Control and Display (RASCAD), the Flight Termination Units (FTUs), communications modems, and the Message Storage Unit (MSU). All equipment is dual-redundant with automatic reconfiguration.

#### 1.2.2.5 John F. Kennedy Space Center, NASA

The John F. Kennedy Space Center (KSC) is located on Merritt Island immediately to the west and across the Banana River from CCAS. KSC provides direct telemetry and communications support for the ER. It is home to both the ER Telemetry Receiving Site and NASA's telemetry receiving station, Merritt Island Launch Area (MILA). In addition, KSC is the relay point for command, radar, and telemetry support from Wallops Island, and satellite and other communications routed through NASA's Goddard Space Flight Center (GSFC) for support of ER operations. KSC's large service infrastructure supports the Air Force and its own vehicle assembly, testing, and launch activities and all of its contractor and civilian support personnel. The Space Transportation System (STS) is launched from KSC launch complexes 39A and 39B.

The telemetry site at KSC is Tel-4/KSC, Station 19. Tel-4 hosts two telemetry antennas a TAA24A and a TAA-3C. The station is capable of data acquisition, data storage, data processing, preparation of computer-formatted magnetic tapes, tape copying tape playback, providing analog charts/recordings and interfacing video retransmission. Separate display areas are equipped with direct write thermal pen recorders, oscillograph recorders, and digital displays for the convenience of range users. Computer-ready magnetic tapes may be formatted in real time or from pre-recorded data tapes. Facilities exist to produce duplicate pre-detection or video magnetic tapes. Signal distribution and interconnection of the data-handling system is accomplished mostly by a remote patch control system known as the video remote patch (VRP) rather than through manual patch panels. Tel-4 also functions as the uprange central receiving and data distribution center and retransmits data via communication links to range user's outside facilities.

#### 1.2.2.6 Jonathan Dickinson Missile Tracking Annex

The Jonathan Dickinson Missile Tracking Annex (JDMTA) at Tequesta, Florida, approximately 100 miles south of Cape Canaveral, is designated Station 28. It is in an isolated corner of the 10,284 acre Jonathan Dickinson State Park. The site was established to replace the upper mid-range resources that were lost when the Grand Turk and Grand Bahama Island facilities were decommissioned. The site provides radar 28.14 (AN/FPQ14), telemetry with 1 TAA-8A and 4 TAA-50 antennas, command, and communications from a unique integrated control facility. JDMTA is a unique station equipped with 2.2-2.4 GHz antenna systems capable of tracking four separate targets. JDMTA also has three high-power command transmitters and three command antennas. The command system antennas include two DATRON steerables with 20$^{o}$ beam-width and one broadbeam fixed antenna with a 27$^{o}$x45$^{o}$ beam. This station has facilities that record, display, and retransmit data directly to Tel-4 for distribution to the Range Operations Control Center (ROCC) for Range Safety display or to outside user facilities. Communications with the Cape are via wide band microwave and landlines.

#### 1.2.2.7 Antigua Air Station

Downrange Station 91, Antigua, is located on the Island of Antigua, British West Indies. The island is about 1,250nm (250 miles southeast of Puerto Rico) in the northern Leeward Islands of the Caribbean Sea. The tiny 108 square mile island is home of both the Air Station and a US NAVFAC. The Air Station provides radar, telemetry, command, and communications in the mid range of trajectories for both ballistic and space launch operations. Radar 91.14 is an AN/FPQ-14. The telemetry facility Station 91, is off the main Air Force base, adjacent to the southeast corner of the airstrip closed runway at Barnacle point. The site has two antennas a TAA-3A and a TAA-8A. Site Communications are via a cable system that extends from Antigua to Puerto Rico, the Virgin Islands, and the mainland and satellite links. Antigua command site is on the station. It has two transmitters and two antennas. The ESCO Tri-helix command antenna has an 18$^{o}$ x30$^{o}$ beam that can be fed from the high or low power feed of the transmitter. The TEMEC dish antenna has an 8.5$^{o}$ beam-width. This antenna is typically used with a high power system.

#### 1.2.2.8 Ascension Auxiliary Air Field

Ascension Auxiliary Air Field is the farthest south of any of the range facilities. It is approximately 5000 miles south east of the Cape in the South Atlantic, 7$^{o}$ 57′ south of the equator. The site was originally developed to support the 5000 mile range requirements for the SNARK and the NAVAHO weapon systems testing programs. Ascension continues to support Navy Ballistic Missile Testing and the upper stage tracking and burn data requirements for some orbital launches. Data and voice communications are relayed via satellite and HF radio. Tracking resources include 12.15 an AN/FPQ-15 radar, and 12.18 an AN/TPQ-18 radar. Ascension telemetry, Station 12, hosts a TAA-C-2, a TAA-3C-1 and two fixed S-band antennas. A command site is not located on Ascension.

## 1.3 EASTERN RANGE COMMERCIAL VEHICLE SUPPORT CAPABILITY

Vehicles launched from the Eastern Range are restricted to certain launch azimuths because of the populated land areas. Specifically, it is required by EWR 127-1 that public risk criteria may not exceed a casualty expectancy of $E_c = 30x10^{-6}$ to orbital insertion. In cases of national need, a waiver may be obtained from the Wing Commander after implementing available, cost effective mitigation. In addition, the flight trajectory must be designed to accommodate Range Safety's capability to control launch related risks. A sufficient safety margin is provided between the intended flight path and protected areas so that a normal vehicle does not violate destruct limits. Also, the launch profile must not be so steep, during the initial launch phase, such that critical coastal areas cannot be protected by standard safety destruct limits.

How close to the continental US or any populated land mass a vehicle may fly is affected by its flight profile and explosive characteristics due to destruct action, impact, or catastrophic events. This can vary significantly by types of vehicles and among flights of the same vehicle, depending on payload and other vehicle configuration differences. The distance between destruct lines and the area they are to protect is entirely vehicle and mission specific. There is no required minimum distance from land for impact limit lines (ILLs). However, jettisoned stages, payload fairings and other normally discarded hardware and their associated 3 sigma IIPs must not fall closer than 100nm off foreign soil. They are positioned to protect any given land-mass (see Figure 1-5). The over-flight of any inhabited land mass is discouraged, and is approved only if operational requirements make over-flight necessary and risk analyses indicate the casualty expectancy is acceptable.

The identification of operation-related hazards and the assessment and quantification of risk is used to determine the operation constraints. The hazards associated with each source of risk (debris impact, toxic chemical dispersion, and acoustic overpressure) have critical parameters and thresholds of acceptability. Changes in launch parameters (azimuth, payload, launch site, etc.) and the need for flight safety controls (evacuation of personnel, enforcement of roadblocks, restriction of sea lanes or airspace, etc.) will depend on the results of the hazard assessments.

Representative allowable launch azimuths and a range grid are shown in Figure 1-5. Trajectory limits are dependent upon the associated risks to the "public domain" and the mission objectives. Launches with azimuths between 44 degrees and 110 degrees, with impact ranges less than approximately 3,500-miles are normally considered to be within the allowable limits. United States Government launches proposed outside of these limits have been approved, based on high priority/national security justifications and detailed risk assessments. At the present time, there are no launch constraints based solely on the physical size of launch vehicles that can be supported at the Eastern Range. The Eastern Range Dispersion Assessment System (ERDAT) has replaced the Meteorological and Range Safety System (MARSS) and has increased capabilities for predicting affected areas and concentrations of toxic commodities for both hot and cold spills.

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# SECTION 2.0
# EASTERN RANGE
# "RANGE SAFETY PROGRAM"

## 2.1 INTRODUCTION

Section 2.0 describes the Safety Organization and the Range Safety (RS) Program for the Eastern Range and provides an overview of the features that comprise this program. The Range Safety Program has the authority and responsibility for both ground and flight activities such as test, checkout, assembly, servicing, and launch of launch vehicles and payloads to orbit insertion or earth impact. The following major topics are addressed:

- Safety Organization and Responsibilities
- 
- Eastern Range Safety Policy
- The Eastern Range Safety Program

## 2.2 SAFETY ORGANIZATION AND RESPONSIBILITIES

A description of the range organization and responsibilities of the Chief of Safety is provided in Section 1. The following is a more detailed discussion of the functional safety responsibilities of the three primary safety sections (SEO, SEG, and SES) and their lower elements that are responsible to the Chief of Safety (see Figure 2-1).

### 2.2.1 Operations Safety and Analysis

Operations Safety and Analysis (SEO) is divided into three elements: Mission Flight Control (SEOO), ELV Operations Support and Analysis (SEOE), and Space Transportation System (STS) Operations Support and Analysis (SEOS).

SEOO is responsible for the following functions:

- Manages the execution of the launch vehicle flight safety program;
- Establishes RS requirements through RS Operational Requirements (RSOR) document;
- Provides oversight for the day-to-day and launch day execution of the flight safety program by the 45th Operations Group MFCOs. This is accomplished by SEOO Safety Technical Advisors (STA) providing support for all launches

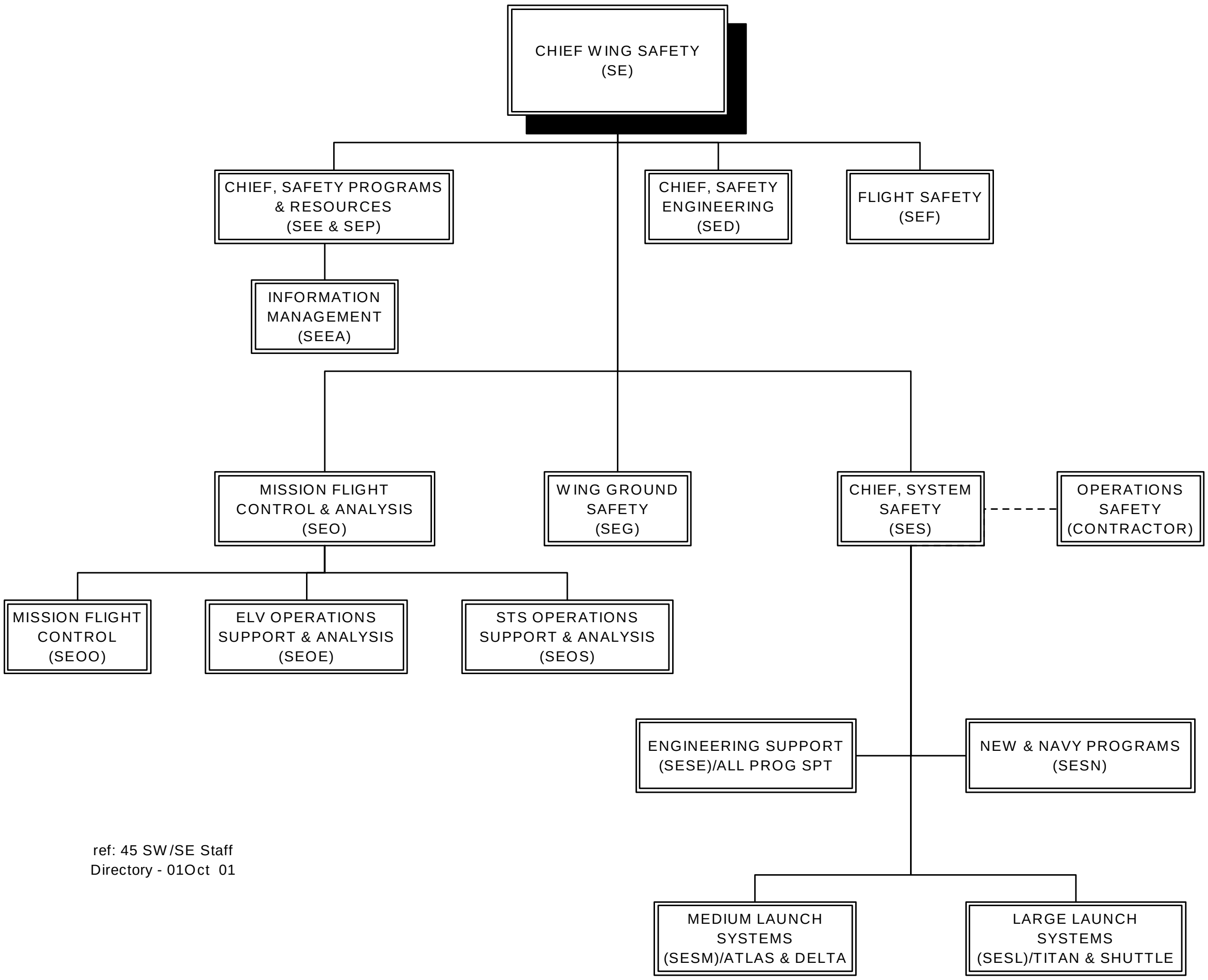



**Figure 2 - 1: 45SW Safety Organization**

- Provides overall management and single point of contact for manned space flight (Shuttle) program;
- Reviews and approves Operations Supplement to RSOR. This is a mission specific document tailoring the RSOR to a particular launch.
- Develops flight control policy for execution by the 45 OG MFCOs;
- Provides engineering support in the design, development, test, and acceptance of flight safety equipment;
- As STA on launch day, provides recommendations to senior Wing Staff and launch decision authority (LDA)on waivers of launch commit criteria and decision to proceed from a safety perspective;
- Provides the MFCO with technical advise as required; and
- SEOO maintains several personnel who are certified as MFCOs and support launch operations in this capacity

SEOE and SEOS are responsible for the following functions (SEOE for Expendable Launch Vehicles and SEOS for Space Transportation Systems):

- Evaluates requests for flight plan approval and safety policy waivers;
- Determines need for flight termination systems on vehicles/payloads/upper-stages
- Analyzes launch vehicle trajectory, performance data, and instrumentation systems;
- Establishes impact limit lines and destruct criteria for each launch;
- Prepares input data to define safety displays for each launch vehicle;
- Computes ship/aircraft hit probabilities and approve intended support plans;
- Develops Range Safety policies, criteria, and operating procedures;
- Establishes requirements for real-time computations and displays;
- Develops mathematical models and programs for computing launch vehicle safety hazards;
- Establishes safe flight conditions for remotely piloted vehicles, aerostats, and "air-dropped" objects;
- Establishes launcher limits and operations restrictions for unguided rockets;
- Programs and operates computer terminals and peripheral equipment;
- Generates MFCO training simulations;
- Provides Chairman for the Interagency Nuclear Safety Review Panel - Launch Abort Sub-panel (INSRP - LASP);
- Implements the Air Force Occupational Safety and Health (AFOSH) program.

These elements are staffed with engineers, computer scientists, and mathematicians that provide technical support for launch pad and in-flight operations. These personnel quantify the risks and establish launch area restrictions and flight termination criteria to ensure that the risks are acceptable. They approve vehicle flight plans with coordination of the 45 SW Commander, and determine the need for Flight Termination Systems (FTS).

### 2.2.2 System Safety

System Safety (SES) is responsible for the following functions (SESS for small solid rocket systems, SESM for medium launch vehicle systems, and SESL for large launch vehicle systems):

- Develops and implements ground/industrial, explosive, nuclear, and system safety programs for the ER;
- Acts as the ER point of contact for all safety matters on policy other than flight and AFOSH Safety Programs;
- Ensures that public and launch site safety and resource protection are adequately provided by and for all programs using the range;
- Conducts specialized safety engineering analyses and studies;
- Provides safety engineering to assist in developing and enforcing engineering design requirements for hazardous launch vehicle flight, ground support, and facility systems;
- Reviews and approves pre-launch hazardous procedures;
- Monitors and controls hazardous operations;
- Develops processes and procedures to mitigate risks involved in pre-launch and launch operations for both the general public and launch site.
- Reviews/approves FTS design and test

EWR 127-1 requires that the single commercial user, full-time government tenant organization, or USAF squadron/detachment commander, as the control authority, has the responsibility for launch complex safety and will exercise the function in accordance with the Range Safety Training and Certification requirements. The control authority has the option of delegating this responsibility to the Chief of Safety. In all cases, the Chief of Safety reviews and approves all hazardous operating procedures and any other procedures that Range Safety may review to ensure such operations do not pose or create a hazardous condition. If requested by the control authority, Range Safety ensures that all hazardous operations affecting launch complex safety are conducted using Range Safety-approved formal written procedures. Through Operations Safety, Range Safety ensures launch complex safety is provided in accordance with EWR 127-1 and approved Operations Safety Plans. If assuming responsibility, the control authority ensures that all hazardous operations affecting launch complex safety are conducted using formal written procedures approved by a space safety professional.

SESE is responsible for systems that are not directly related to a specific type of launch vehicle. For example, SESE develops flight termination system design criteria and requirements, reviews and approves qualification and acceptance tests, defines checkout requirements, and approves the FTS.

SESP is a special section responsible for safety concerns on classified payloads.

### 2.2.3 Ground Safety

Ground Safety (SEG) is responsible for the following functions:

- Manages the ground, traffic, aircraft, and safety programs at Patrick Air Force Base (PAFB), Eastern Range downrange, and non-launch vehicle facilities at the Cape Canaveral Air Station (CCAS);
- Provides technical guidance in ground, flight, and safety matters for 45 SW, tenants, at these stations;
- Inspects government operations to ensure compliance with safety standards;
- Investigates, reports, and analyzes mishaps and develops corrective actions to prevent mishaps;
- Manages the hazard reporting and abatement programs;
- Conducts the Commander's Consolidated Safety and Health Council meetings;
- Trains unit safety representatives for all government units at ER stations;
- Develops and presents safety training programs as required;
- Manages the Hazardous Air Traffic Report and Bird/Aircraft Strike Hazard Reduction programs.

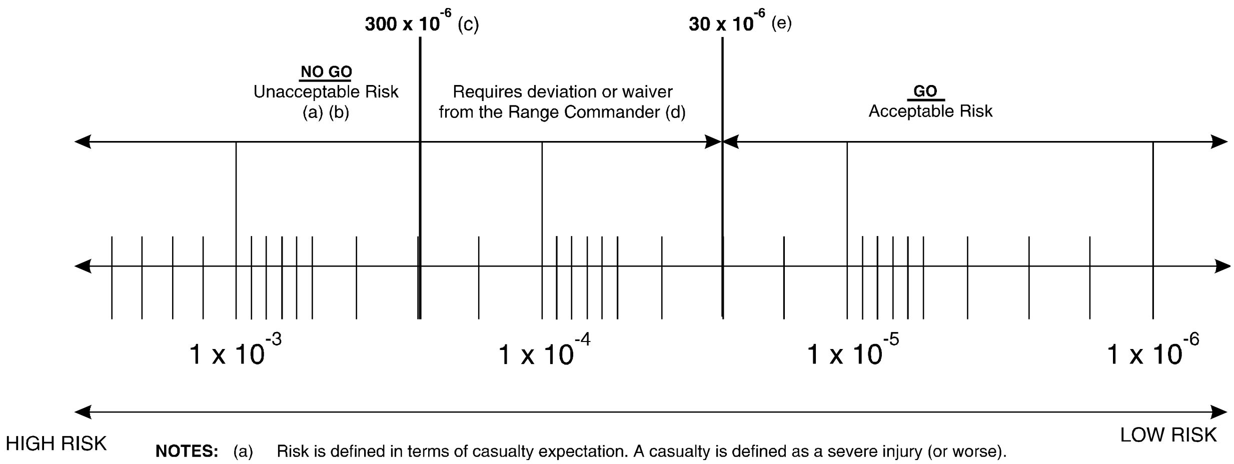
## 2.3 EASTERN RANGE SAFETY POLICY

### 2.3.1 Public Exposure

The ER acceptable risk guidance for public exposure to launch operations is shown in Figure 2-2. In addition, an impact probability ($P_i$) of $1 \times 10^{-6}$ is usually the basis for aircraft approval and a ship-hit probability of $1 \times 10^{-5}$ is usually acceptable for ships. These numbers are used as guides, not hard limits. The range user must endeavor to maintain the lowest risk level possible, consistent with mission requirements. Individual hazardous activities may exceed guidance based on national need or use of risk mitigation techniques.

The ER strives to ensure that the risk to the general public and foreign countries from Range operations does not exceed the risk to the general public from all natural causes and meets the guidance established in the legislative history of Public law 60. To that end, the Range will:

- Control all pre-launch and launch operations conducted on the range to ensure that the hazards associated with propellants, ordnance, radioactive materials, and other hazardous systems do not expose the general public to risks greater that those considered acceptable by public law and state regulations.
- Conduct and oversee launch and flight operations in a manner to ensure the risks to the general public, foreign countries, and the launch area do not exceed acceptable limits consistent with mission and national needs.
- Verify that all space vehicles and launch vehicles launched from or onto the ER have a positive, range approved method of controlling errant vehicle flight. This control must meet the objective of minimizing risk to the general public and foreign countries.




**NOTES:**
(a) Risk is defined in terms of casualty expectation. A casualty is defined as a severe injury (or worse).
(b) Unacceptable risk to the general public; does not meet the intent of PL60 or DODD 3200.11.
(c) The upper bound for essential launch area personnel is based on one casualty per 100 years with a launch rate of 33 per year.
(d) Cumulative risks at this level from multiple launches may drive the annual risk to be unacceptable.
(e) The upper bound for GO is based on an equivalent to an average of one casualty per 1000 years, with launches at the rate of 33 per year and assuming a population of 250,000 in the area of the launch facility.

("From a Safety Standpoint, they (missiles) will be no more dangerous than conventional airplanes flying overhead." Legislative History, 81st Congress, pg. 1235)

**Figure 2 - 2: Risk Level Guidance for Public Exposure**

## 2.3.2 Control Systems

Normally, control systems on launch vehicles using the range shall consist of an airborne Range Safety System meeting the requirements stated in the Range Safety Requirements, EWR127-1 (This document is available from the office of (Range Safety). A thrust termination system may be considered as an alternative to an FTS, however, quantification of risks must be determined.

### 2.3.3 Clearance Zones

Safety clearance zones and procedures to protect the public on land, on the sea, and in the air are established and controlled for each launch and launch vehicle using the ER.

- No intact space vehicle, launch vehicle, payload, reentry vehicle, or jettisoned vehicle part is allowed to intentionally impact on land. Flight paths and trajectories are designed so that normal impact dispersion areas do not encompass land.
- Errant launch vehicles may be allowed to fly to obtain maximum data until they approach the point of presenting an unacceptable risk to the public, or the point where Range Safety is in danger of losing control the vehicle.
- Each launch system must have a hold-fire capability that prevents launch in the event of an unsafe range condition, loss of critical Range Safety systems, or violation of mandatory Range Safety criteria. Safety holds are initiated to prevent the start of an operation, or to stop an operation that is already underway, if it violates public safety, launch complex safety, or launch commit criteria. These holds may be called if safety criteria are violated or if adequate safety can not be ensured when personnel or resources are jeopardized. Safety holds may be initiated by Mission Flight Control Officers, Operations Safety Manager, Range Control Officers, range user, or any responsible supervisor in charge of an operation.

### 2.3.4 Safety Approvals

In order to operate, use, or launch from or into the ER, specific mandatory safety approvals must be obtained to show compliance with the requirements of the ER. In addition, commercial users must have an approved FAA license and meet the requirements of established regulations.

#### 2.3.4.1 Wing Commander Approvals

The following safety approvals require the signature of the ER Commander:

- Tailored versions of EWR 127-1 affecting public safety;
- Range Safety mission flight rules for the Space Transportation System, including termination (errant vehicle control) criteria. All other launch vehicle mission flight rules are briefed to the Wing Commander but are not formally approved by signature;
- Range Safety launch commit criteria for the Space Transportation System. All other launch vehicle LCC are briefed to the Wing Commander but are not formally approved by signature;
- The launch of launch vehicles whose risks to the public exceed 30 x $10^{-6}$;
- The launch of launch vehicles containing explosive warheads;
- The launch of nuclear payloads;
- Non-compliance affecting public safety.

#### 2.3.4.2 Chief of Safety Approvals

The Chief of Safety or his designated representative may sign the following safety approvals:

- Flight Plan Approval. A flight plan approval must be obtained prior to the range commitment to support a final launch readiness review. Plans, required data, and formats, together with submission lead times, are described in Chapter 2, EWR 127-1. (See Table 2-1)

**Table 2 - 1: Lead Times for Required Data**

| Type of Launch Vehicle | Type Mission/Condition | Lead Time Before Launch Calendar Days |
|---|---|---|
| New System/Program | First launch or Test | |
| Preliminary Flight Plan Approval | | One Year |
| Final Flight Plan Approval | | 4 months-2 months |
| Ballistic Launch Vehicle (1) | Single Flight Azimuth, Multiple Trajectory or Flight Azimuth | 60 Days |
| Space Vehicle (1) | Single Flight Azimuth or Variable Flight Azimuth | 60 Days |
| Cruise Launch Vehicle/Remotely Piloted Vehicle | Ground or Air Launched | 60 Days |
| Small Unguided Rocket | Without Destruct System | 60 Days |
| Aerostat/Balloon | Tethered or Un-tethered | 60 Days |
| Projectile, Torpedo, Airdropped Body or Device | Miscellaneous | 60 Days |
| Support Aircraft/Ships | Intended Support Plans | 20 Days |

Note: (1) Programs with Flight Plan Approval

- Range Safety System Approval. The range user in accordance with Section 4.4 and Appendix 4A of EWR 127-1 shall submit a Range Safety System Report (RSSR).
- Missile System Pre-launch Safety Package (MSPSP) Approval. The range user in accordance with Section 3.4 and Appendix 3A of EWR 127-1 shall submit a MSPSP.
- Launch Approval. Wing Safety's GO at the Launch readiness Review (LRR) normally constitutes approval to launch, and is contingent on the Range User having obtained the required approvals identified in Chapter 1 of the EWR 127-1. Lack of approval may result in the launch being withdrawn from the Range schedule.
- The following safety approvals shall be authorized by the Chief of safety or a designated representative:

  Non-compliance not affecting public safety

  System Safety Program Plan

  Launch Complex Safety Training and Certification Plan

  Preliminary and Final Flight Data Packages

  Aircraft and Ship Intended Support Plans

  Directed Energy Plans

  Hazardous and Safety Critical Procedures

  Facilities Safety Data Package

  Final Range Safety Approval for launch

  Range Safety Instrumentation, tracking, data, & display requirements for all vehicles

## 2.4 THE EASTERN RANGE SAFETY PROGRAM

The objective of the Range Safety Program is to ensure that the general public, launch area personnel, foreign land masses, and launch area resources are provided an acceptable level of safety and that all aspects of pre-launch and launch operations adhere to public laws and national needs. The mutual goal of the Ranges and Range Users shall be to launch vehicles and payloads safely and effectively with commitment to public safety

### 2.4.1 Launch Vehicle System Ground Safety

All flight hardware, ground support equipment, facilities, and operations associated with activities on the ER that have the potential to present a hazard to the general public must be approved by Range Safety. This approval is given when Range Safety has received, reviewed, and approved the data contained in the Missile System Prelaunch Safety Package.

#### 2.4.1.1 Missile System Prelaunch Safety Package

The Missile System Prelaunch Safety Package (MSPSP) is the data package that describes in detail all hazardous and safety critical systems/subsystems and their interfaces in vehicles, payloads, ground support equipment, facilities, and launch pads. In addition, the MSPSP provides verification of compliance with EWR 127-1 and Appendix 3A. The MSPSP must be approved by Range Safety prior to the arrival of any launch vehicle/payload element, activation of a hazardous processing facility, or commencement of any hazardous operation on the ER. Supporting documentation is submitted as deemed necessary by Range Safety. The following is typical of the information presented in the MSPSP.

##### 2.4.1.1.1 Introduction

This section contains brief statements of the purpose of the MSPSP, the type of launch vehicle, payload and mission, a brief description of changes from previous vehicles/payloads, and other general information thought to be useful, such as sketches of the vehicle, payload, or facility.

##### 2.4.1.1.2 General Description of the Launch Vehicle, Payload, and Facilities

This section provides an overview of the system as a prologue to the subsystem descriptions. It also includes information as to physical dimensions and weight, nomenclature of major subsystems, type of motors and propellants to be used, and sketches/photographs of the vehicle/payload/facility. A synopsis is provided for each hazardous subsystem.

##### 2.4.1.1.3 Subsystem Description

This section describes each of the hazardous subsystems by giving an overview of each system, and then describing each item in terms of nomenclature, function, location (using sketches), operations (using schematics and /or flow charts), design parameters, testing, operating parameters, and hazard analyses. Supporting data is included or summarized and referenced, as appropriate, with availability upon request. Specific data requirements for hazardous subsystems are contained in EWR 127-1; however, additional data may be required, as necessary, to substantiate the safety of the system. Tables, matrices, and sketches are required to provide component data. The MSPSP must have a subsection for each of the following systems, subsystems and components:

- Structures/Mechanisms
- Propellant and Propulsion Subsystems
- Electrical and Electronic Subsystems
- Pressure Subsystems
- Ordnance Subsystems

- Non-Ionizing Radiation Subsystems
- Ionizing Radiation Subsystems
- Acoustical Subsystems
- Hazardous Materials
- Computing Data Systems
- Ground Support Equipment (GSE) (including government-furnished and Range Contractor-furnished equipment). The GSE section must be organized by hazardous subsystem and shall account for all GSE. A section on personal protective equipment is also provided.
- Subsequent sections are added, if required, to provide any other data pertinent to the safety of prelaunch and launch operations. Range Safety will request additional information, as required, for a thorough assessment of the system.

#### 2.4.1.1.4 Ground Operations

The following information can be submitted separately as part of a Launch Base Test Plan or Ground Operations Plan if so stated in the MSPSP. Separate submittals must be provided with each MSPSP and must, as a minimum, identify the ground processing flow, including all hazardous operations.

- All procedures (hazardous and non-hazardous) that are to be used at the range must be listed by title and numerical designation with an indication as to which have been designated as hazardous or related to flight termination system operations. Procedure descriptions must include separate listing of tasks so those hazardous tasks within each procedure can be identified.
- A task summary of each procedure must be provided. This must include: each separate task, responsible agency, objective, initial/final configuration, equipment/support required, description, hazards and precautions, and figures, if required.
- A flow chart must be included that indicates expected time sequence and location of each individual procedure/task. The purpose of this is to evaluate simultaneous operations, hazards, and controls, and to ensure changes in the hazardous configuration of the facilities and hardware are identified. This flow chart must include an identifier for each procedure. The identifier contains procedure number, hazardous or non-hazardous designation, and task summary number.
- Provisions for emergency and abort/back-out situations must be identified.

#### 2.4.1.1.5 Off-site Processing

Range users must provide a detailed description of off-site configuration (both build-up and transport) for booster/payload elements that will be transported to the Cape Canaveral Air Station. A description must be provided of the tests performed on safety critical systems, such as rotation of Safe & Arm devices, no voltage checks of ordnance, pressure checks of pressure/propellant vessels, RF radiation measurements, and preliminary FTS checks. In addition, five working days prior to hardware arrival at CCAS, the user must provide the following to Range Safety for approval:

- A final transportation plan;
- A statement certifying that the configuration of hazardous systems has not changed from the approved configuration described in the MSPSP;
- A statement certifying that the flight termination system (if installed) has not been modified, moved, or readjusted without being witnessed and approved by Range Safety or their representative.

#### 2.4.1.1.6 Compliance Checklist

A checklist of all design, test, and data submittal requirements in EWR 127-1 must be provided in the MSPSP. The checklist must indicate the following for each requirement:

1. criteria/requirement
2. system
3. compliance
4. non compliance
5. not applicable
6. resolution
7. reference

#### 2.4.1.1.7 Changes to the MSPSP

Changes to the MSPSP should reflect any system or component changes. All changes must be reviewed and approved by Range Safety prior to arrival of modified/new hardware.

### 2.4.1.2 System Modification

Once hazardous systems have been approved, their configuration, components, and interfaces with other systems are not modified without Range Safety concurrence.

## 2.4.2 Flight Safety

This section covers the requirements that the range user must meet before conducting a mission or flight operation on the Eastern Range. These requirements are for trajectory data and system flight characteristics for ballistic launch vehicles and space vehicles. It also covers the data requirements and procedures for obtaining approval for mission flight plans. Using the data submitted by the range user, Range Safety analyzes each mission from a flight safety standpoint and prepares safety criteria for the safe conduct of the mission.

### 2.4.2.1 Flight Plan Approval

The Flight Plan Approval (FPA) of a proposed flight plan or mission by the Chief of the Safety Office, or a designated representative (SEO), is a necessary prerequisite for flight operations and tests, and indicates the hazards associate with the launch are at an acceptable level. The range user should initiate flight plan approval action at the earliest practical date to establish that the proposed mission or trajectory is acceptable from a safety standpoint. Ideally, flight plan approval (FPA) for each mission should be requested during the initial planning or conceptual phase. For new programs, a request should accompany the Program Introduction or, in any event, be submitted immediately after the range has replied to the Program Introduction with a Statement of Capability or at least 2 years prior to launch. For launch vehicle programs already active on the range, discussions and correspondence concerning flight plan approval should begin at least one year prior to launch.

The flight plan approval request addresses the applicable requirements of EWR 127-1 to the greatest extent possible. In many cases, the information provided suffices for evaluation of the flight plan. In other cases, where the proposed plan exceeds normally accepted limits, such as flying a trajectory too steep to allow protection of the launch area, flying too close to or spending too much-dwell time over land, or impacting jettisoned vehicle parts too close to land, additional data will be required. In any event, Range Safety will respond in writing to the flight plan approval request by issuing a letter of approval or disapproval, by requesting that a change in the proposed plan be made or investigated, or by delineating the additional data required before a decision can be made. Trajectory data are examined after flight plan approval; in order to do risk analyses (see paragraph. 2.4.2.6).

The approval letter will specify the conditions of approval pertaining to such things as flight azimuth limits, trajectory shaping, wind restrictions, locations of impact areas, times of discrete events, and number of vehicles or missions for which the approval applies. The approval will be final as long as the mission remains within the stated conditions.

#### 2.4.2.2 Flight Plan Approval Procedures

The range user should submit a FPA request as early in the planning phase of the program as possible. The information that should be submitted with the request is specified in EWR 127-1. If sufficient data are not available to meet the requirements, the range user should meet with SEO to discuss the program and to provide all available information. SEO will review the available data and advise the range user of additional data or hazard analyses that are required. At this time in the program development, the design of the vehicle systems may not be fixed. SEO will make the range user aware of the flight safety requirements so that the design of the safety systems and other systems will meet the requirements of EWR 127-1.

Significant in the approval procedure is that the range user provide all data needed by SEO early enough that the processing of the FPA request can be completed prior to the time that the design of all systems that affect safety are finalized. If the SEO processing takes two months, the range user's data must be submitted two months before systems are finalized or two months before the range user requires FPA, whichever is earlier.

#### 2.4.2.3 Flight Plan Approval Letter

The range user is advised, as soon as possible, of the acceptability of the vehicle safety systems and the flight plan. This information can be communicated in briefings, telephone conferences, and letters to allow the range user to expedite making modifications or submitting waiver requests to conform to the safety requirements. Formally, a FPA letter is prepared by SEO that sets forth the safety position of the range user's request for FPA, which is signed by the Chief of Safety or his designated representative. This letter contains the following information, as applicable:

- The requirement, or lack thereof, for an FTS on stages or payloads to control the flight of a malfunctioning vehicle.
- The adequacy of a command control system throughout powered flight in accordance with EWR 127-1;
- FPA is based on final trajectory data.
- An assessment of over-flight casualty expectancies associated with the planned launch and a comparison of these hazards to previously acceptable casualty expectancies for similar flights;
- Any restraints on the launch, such as flight azimuth or launch area wind conditions;
- Description of waivers that have been requested by the range user and their resolution;
- A statement that final trajectory data for the launch must be provided in accordance with EWR 127-1 even though the FPA is granted;
- Any other information that the SEO analyst believes is qualifying to the FPA.

#### 2.4.2.4 Flight Safety Restrictions

No launch vehicle, space vehicle, payload, reentry vehicle, or jettisoned component will be intentionally impacted on land. Proposed flights must be planned and trajectories shaped so that normal impact dispersion areas for such items do not encompass land. A sufficient safety margin should be used to avoid overly restrictive flight termination lines. If a stage contains multiple-burn engines, the impact dispersion area corresponding to any planned cutoff before orbital insertion must be entirely over water. Critical events (such as arming of engine cutoff circuits and sending of backup engine cutoff commands) must be sequenced to occur when the impact dispersion areas are entirely over water.

#### 2.4.2.5 Flight Termination Systems

All vehicles launched on the range must be equipped with a flight termination system that meets the requirements defined in EWR 127-1. This system must be redundant and capable of termination of thrust on any or all stages at any time in flight, up to the point of final impact or orbital insertion. The overall system reliability goal of the flight termination system is a minimum of 0.999 at 95% confidence. Using the design approach and testing requirements described in EWR 127-1 satisfies this reliability goal. Small rockets whose impacts can be adequately controlled by pre-launch restrictions are excluded from this requirement.

#### 2.4.2.6 Flight Safety Analysis

Before flight plan approval is granted, the range user must submit a Flight Data Package, which provides detailed trajectory and vehicle performance data, in specified formats, in accordance with lead times established in Table 2, and required by EWR 127-1. If the deadlines for trajectory and vehicle performance data are not met, the Flight Analysis Section may be unable to prepare the necessary safety criteria in time to support a proposed flight test or operation. In this event, the test or operation will not be conducted until adequate safety preparations can be made.

SEO uses the data submitted in the Flight Data Package to assess flight plan approval and prepare safety criteria designed to protect critical areas from the potential hazards of an errant vehicle. Critical areas are generally populated, but can also include critical facilities and launch vehicles. Unpopulated land masses, boats, ships, and aircraft routes can also be considered critical depending on the launch vehicle and its trajectory. Sets of criteria are developed for each launch for presentation on the MFCO console. The Range Safety displays show real-time plots of Instantaneous Impact Point (IIP) and Vertical Plane (VP) present position data plotted over background displays. The background contains nominal and dispersed trajectories that define the limits of a normally performing vehicle, and IIP and VP destruct lines. A normally performing vehicle is one that does not exceed three-sigma performance limits. Any deviation outside these limits indicates that the vehicle is not performing within normal limits, though not necessarily posing a threat to populated areas. The flight termination criteria ensure that MFCO destruct action will not be taken for a vehicle performing normally within three-sigma limits.

##### 2.4.2.6.1 Impact Limit Lines

Impact Limit Lines (ILL) are established to define the launch and downrange areas to be protected. Significant debris pieces that could cause personal injury or property damage from malfunctioning launch vehicles must be contained inside the ILLs. The northern ILL, which is extended to the north and east of CCAS, is designed to protect commercial air lanes north of the CCAS, depending on the vehicle launch location and flight azimuth. Air traffic is closed in the critical air lanes if they cannot be protected. Regardless of air lane protection, the northern ILL is extended to protect the coast of Florida and the Azores, Canary Islands, Cape Verde, and the West Coast of Africa. The southern ILL for all launches is extended south and east of CCAS and protect the coast of Florida until 27 degrees latitude and then continued in straight line segments off the coastline of the Bahamas and on to the Lesser Antilles and to South America. The southern ILL can be extended southeast from the coast of South America to protect the area downrange and South America (see paragraph. 2.4.2.6.7). An eastern ILL, which runs north south and joins the northern ILL with the southern ILL, protects all land areas of Africa except downrange of the African gate. (See Figures 2-3 and 2-4.)

#### 2.4.2.6.2 Destruct Lines

Flight termination, or destruct lines, are designed to protect areas behind ILLs from vehicle malfunctions that result in the violation of a particular destruct line. The destruct lines are presented as solid lines on the Range Safety display IIP maps. The reason these lines are offset from, and inside, the ILLs is because the vacuum IIP presentation does not include drag, wind, and explosion velocities. Activation of the flight termination system by the MFCO, upon violation of the destruct lines, prevents significant debris from exceeding the ILL. The separation distance between destruct lines and ILLs is a function of system delays, data uncertainties, MFCO reaction time, winds, explosion velocities, and performance characteristics of the vehicle. (See Figure 2-4.)

#### 2.4.2.6.3 Launch Area Safety Criteria

Present position and impact prediction displays are used for protection of the critical launch areas. Multiple sets of launch area criteria are prepared for the vertical plane present position, chevron lines, and launch area IIP displays based on two or three different wind conditions. These wind conditions are statistical wind profiles and are characterized in terms of percentiles for monthly, seasonal, or annual periods. The profiles show wind direction and velocity vs. altitude. The sets of criteria prepared reflect the least to the most restrictive wind profile that does not endanger the flight of a vehicle performing within normal limits. Of these sets, the one that best reflects the winds forecast for the time of launch will be determined by SEO during the minus count using the Range Safety Wind Check computer program.

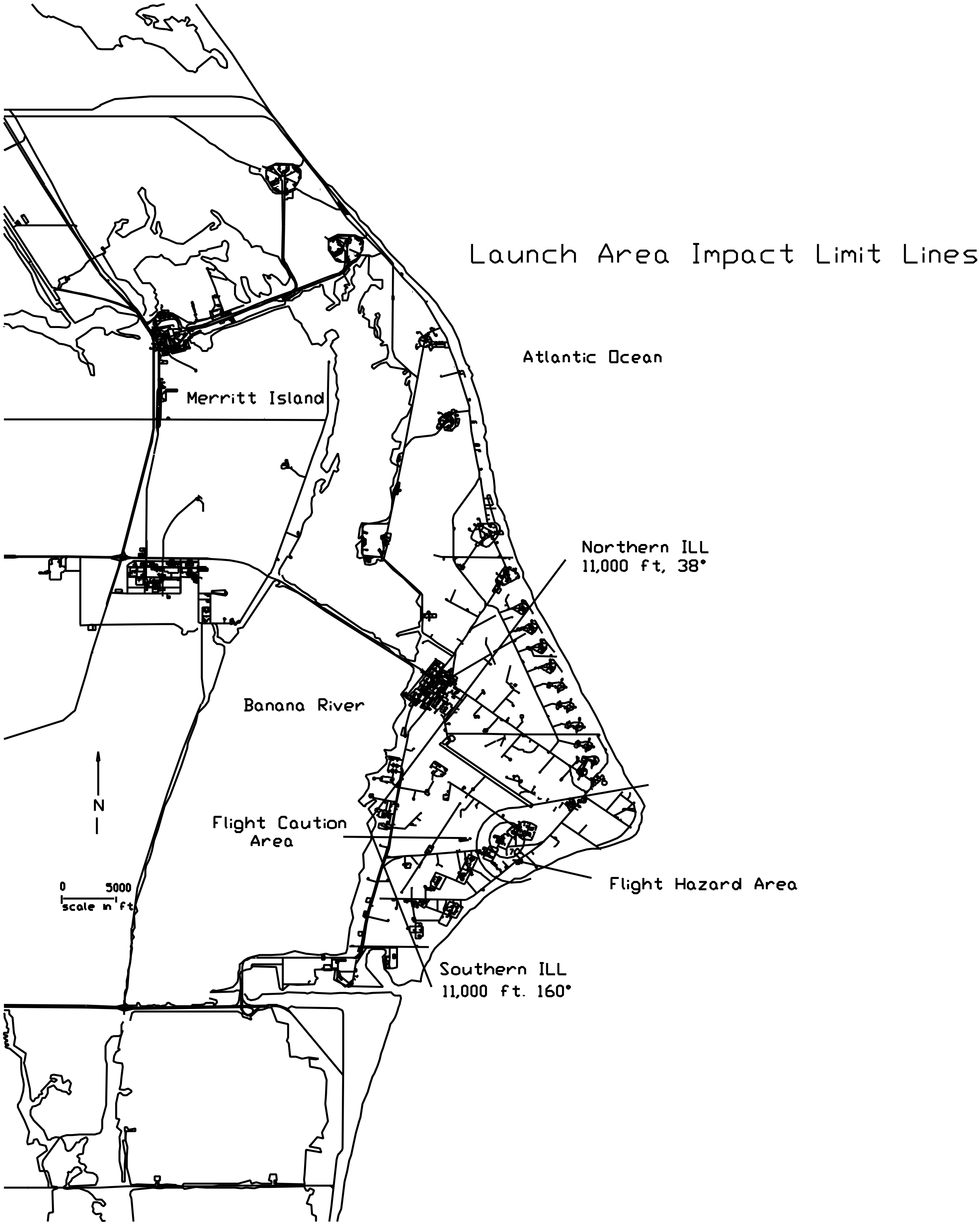



**Figure 2 - 3: Example of Launch Area ILL, FHA and FCA**

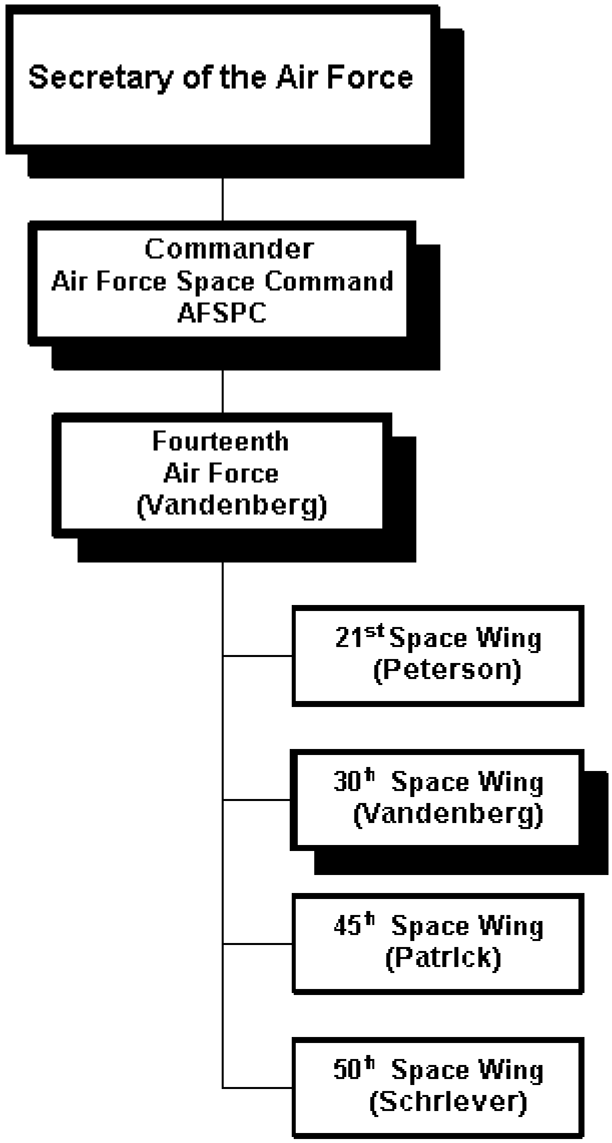



**Figure 2 - 4: Impact Limit Lines and Destruct Line Examples**

#### 2.4.2.6.4 Instantaneous Impact Point

Real-time computer programs receive tracking system and vehicle telemetry data from the Eastern Range, NASA, and other instrumentation systems. The real-time computer system computes and outputs the IIP of the vehicle to the Range Safety display system. The nominal and three-sigma reference trajectories are displayed along with applicable destruct lines/criteria as background references. The MFCO monitors the real-time IIP throughout powered flight. Since the MFCO must determine that the IIP of the vehicle is within safety constraints as it progresses downrange, the IIP is displayed on several progressive maps (up to 12). Map centers and scales are designed to ensure adequate resolution and overlap, and to avoid loss of coverage. The maps gradually decrease in scale as the vehicle progresses downrange, with computer logic determining when to switch maps.

#### 2.4.2.6.5 Vertical Plane Present Position

Projections of the present position trajectory are displayed on two vertical planes (VP), referred to as XZ and YZ, for comparison with the nominal trajectory and launch area safety criteria. The XZ plane that protects the Northern ILL is the right half of the display and the YZ plane that protects the Southern ILL is the left half of the display. The safety criteria or destruct lines shown on these displays are designed to protect the critical areas in the launch area. The nominal and dispersed trajectories, for both the XZ and YZ planes, are shown for MFCO reference. The dispersed trajectories consider performance variations and extreme winds, and define the normal vehicle operating limits. Launch area safety criteria, or destruct lines presented in these vertical planes, take on the form of a family of curved lines. Safety criteria are violated when the track of the vehicle becomes parallel to a destruct line (see Figure 2-5).

Vertical plane destruct lines are generated by a combination of computer programs. Input data consist of nominal trajectory position and velocity components, maximum turning rates of the vehicle, vehicle debris class breakup data, and explosion velocities imparted to vehicle debris as a result of flight termination action. Also input are the range from the pad to the ILL and selected wind profiles. The total time delay used in the vertical plane destruct lines is usually 4.0 seconds (this includes the MFCO reaction and decision time of 2.5 seconds).

The time that a nominally performing vehicle can no longer rise vertically (straight-up time) without having the capability to endanger the impact limit line is shown in the center of the vertical plane display. Typical straight-up times are Atlas-70 seconds and Delta-30 seconds.

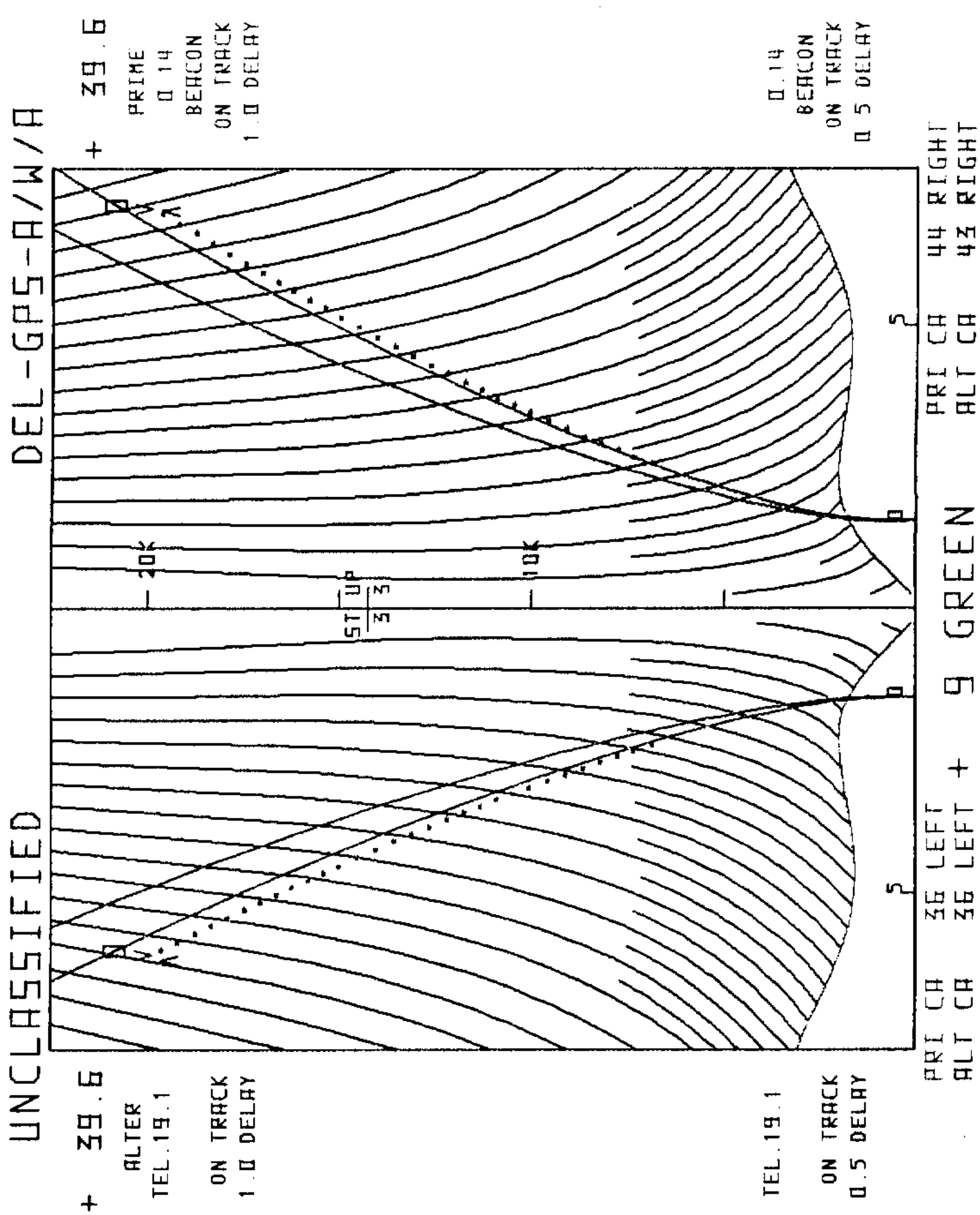



**Figure 2 - 5: Vertical Plane Display Example**

#### 2.4.2.6.6 Chevron Lines

Moving (multiple) destruct lines are developed to protect the launch area ILLs from a vehicle pitching up with the IIP moving up-range. These moving destruct lines are presented as a function of vehicle velocity. The shape of these lines takes on the appearance of chevrons; hence they are named chevron lines (see Figure 2-6). In real-time, the chevron lines are presented at ten points per second as a function of velocity on the Range Safety display. As the velocity changes, the chevron line is updated and appears to be a continuously moving line. The criterion for acceptable vehicle performance is that the vacuum impact point of the vehicle is on or downrange of the applicable chevron line. An impact point uprange of the line violates the chevron line destruct criteria. The chevron line disappears from the display when the vehicle velocity exceeds the velocity associated with the last chevron line. Input data are similar to data required for computing vertical plane destruct lines.

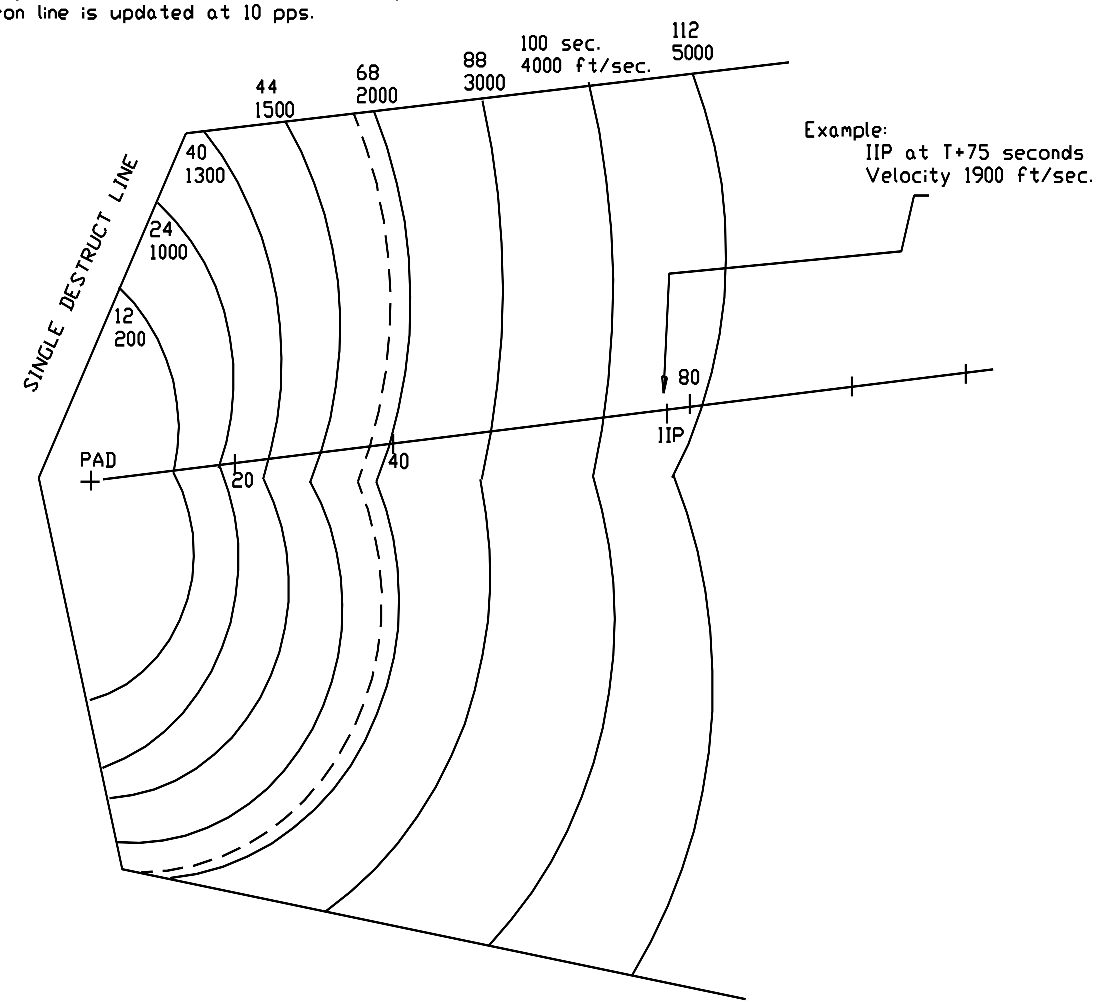
#### 2.4.2.6.7 Downrange Safety Criteria

Downrange background displays are prepared for the protection of downrange critical areas. These displays consist of flight termination criteria in the form of single destruct lines and informational plots of the nominal and three-sigma right and left vacuum impact point loci. The three-sigma impact point loci define the normal limits of lateral impact point dispersions considering winds and performance variations. The real-time IIP is calculated at ten points per second and sent to the Range Safety displays. Staging times and other critical in-flight events are also shown as background data for the MFCO.

Single destruct lines on the IIP displays protect downrange critical areas from the launch area to a point downrange where the vehicle passes through the African European Gate. Although available for the early phase of flight, they are seldom used then because vertical plane and chevron safety criteria are specifically designed to protect the launch area and are presented until the vacuum impact point is about 100 miles downrange.

The vacuum impact point track associated with orbital missions from CCAS passes over landmasses such as Europe, Asia, or Africa prior to orbital injection, depending on launch azimuth (see Figure 2-7). Therefore, the single destruct lines protecting these land areas must be opened to allow vehicles performing within normal limits to over-fly land. Openings in destruct lines may also be needed earlier in flight for missions that fly over, or too close to, land to allow the flight of a vehicle performing within normal limits. These openings are referred to as “Gates”. The size of a gate is dependent upon the space booster and +/- three-sigma trajectories (see Figure 2-8). The use of gates is covered in the mission rules for each applicable operation.

Time, velocity and geodetic coordinates of solid lines input to Cyber by SEY.
Chevron line is interpolated from input lines as a function of velocity and appears to move.
The dashed line, determined by linear interpolation between the 1500 and 2000 ft/sec. chevron lines, is the only chevron line (1900 ft/sec.) displayed at this instant of time.
Chevron line is updated at 10 pps.




Chevron number is determined by subtraction from the time it would take for the chevron line to reach the IIP by the time that a nominal vehicle would achieve the present velocity. For this example, the first time is determined by linear interpolation between the 100 and 112 chevron lines. Assume 105 seconds. The time to be subtracted is that time that a nominal vehicle would achieve a velocity of 1900 ft/sec. (from table look-up). Assume 65 seconds, 105 minus 65 would give a chevron number of 40 for this example.

**Figure 2 - 6: Chevron Lines Example**

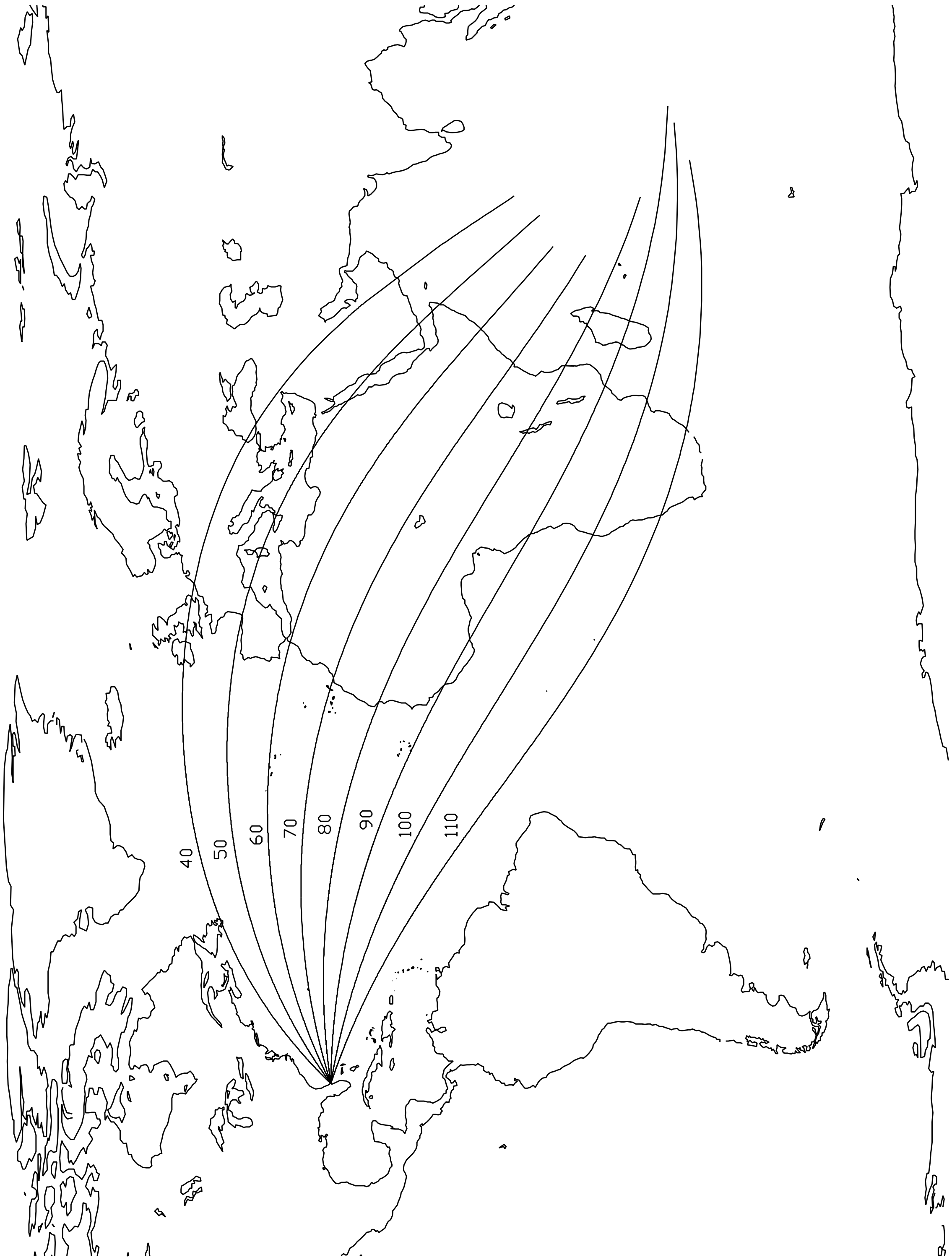



**Figure 2 - 7: Typical Ground Traces for CCAS Launches**

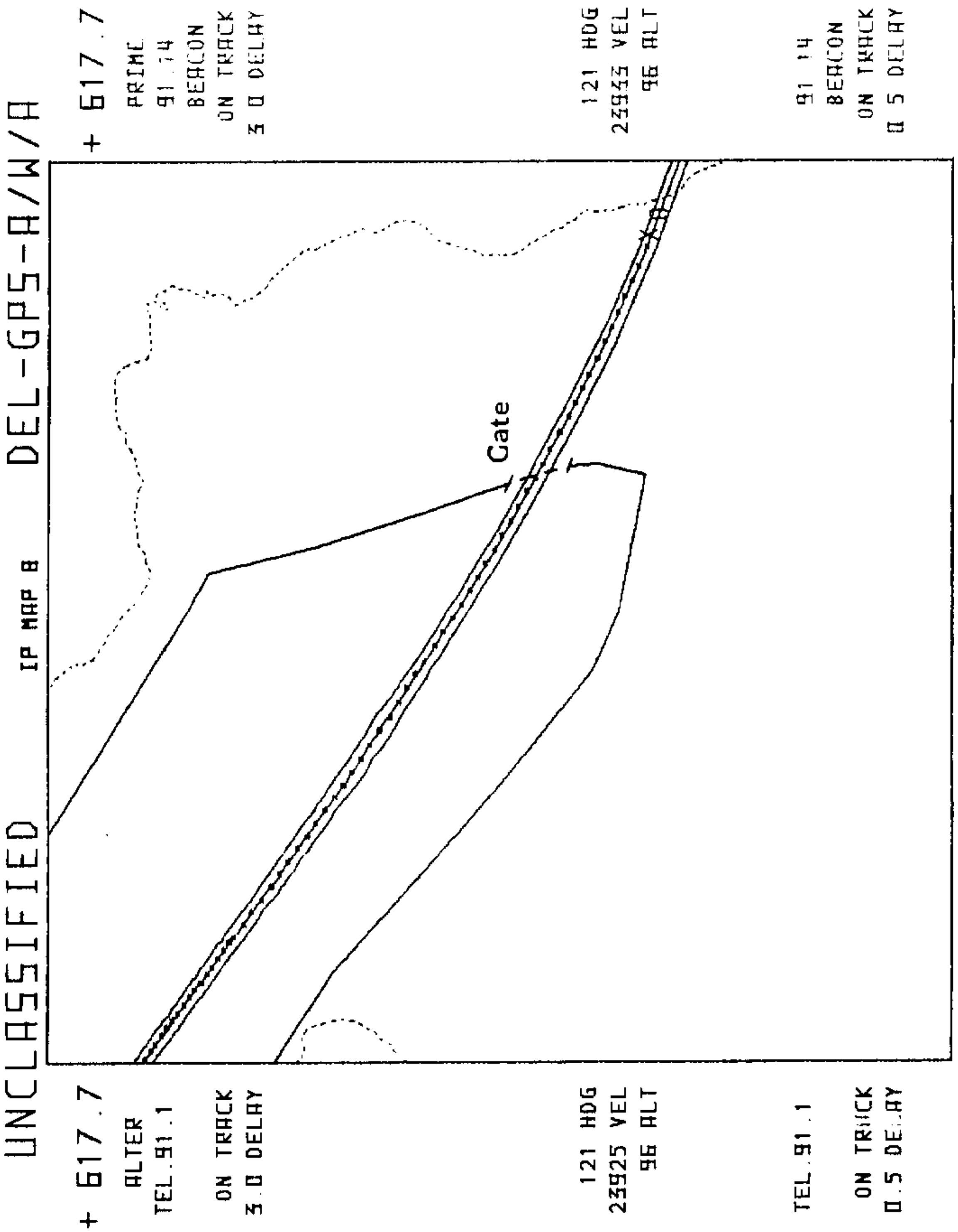



**Figure 2 - 8: Example IIP Chart with Gate**

### 2.4.2.7 Flight Safety Data

The range user must provide data to SEO that can be used to process a Flight Plan Approval request and prepare the safety criteria for the launch of a vehicle. AFSPC 80-12 (Draft), Standard Theoretical Trajectory Magnetic Tape Format, lists specific digital data requirements, coordinate systems, time intervals, and the precision required of the trajectory data for space and ballistic vehicles. The lead times (see Table 2-1) and procedures required for submitting data to SEO are included in EWR 127-1. Data required fall into three groups: digital trajectory data, vehicle turning rates, and vehicle breakup data. Additional information required include descriptions of the performance capability of the vehicle that does not lend itself to a digital format. Examples of such performance information could be typical vehicle failures, reliability of stages, and payload description.

- Digital Trajectory Data. The purpose of the different trajectories (nominal, three-sigma right, three-sigma left, steep, and lateral) that are provided to SEO is to identify an expected vehicle track or trajectory (referred to as nominal) and the spatial bounds of a vehicle performing within normal limits. Position data that are presented on launch-area, vertical-plane, present-position displays define the region of user-described normal vehicle performance. Instantaneous Impact Points may be used in addition to position data for some vehicles. The three-sigma lateral (right or left deviation) impact points define vehicles performing within normal limits in the downrange area. These data are presented on IIP displays for comparison to the actual track of the vehicle.
- Vehicle Turning Rates. If the MFCO decides to terminate the flight of the vehicle, there are system delays, such as time to transmit destruct signal, that must be considered to safely contain the vehicle impact point. As a result, there is a time delay that may occur during flight in which the vehicle's impact point may deviate prior to destruct. System delays affect the displayed position as the MFCO monitors the downrange flight of a vehicle. The region of possible impacts can be defined if the maximum angle that the velocity vector can turn through at any time in flight is known. This established the requirement for vehicle maximum turn rates.
- Vehicle Breakup Data. The breakup of a vehicle is significant in the preparation of destruct criteria. The analyst must model the entire breakup configuration with a relatively small number of debris classes. Pieces, such as bottles, motors, and propellant chunks can explode upon impact and cause hazardous overpressures or fragments that cover a large area. Inert pieces can have different velocities imparted to them by pressure release or explosion. A further problem, especially in the launch area, is establishing the limits of protection for lighter pieces that may drift considerably in the presence of winds. Depending on the pieces selected to represent the vehicle breakup; it may be necessary to set constraints on the wind velocity and direction at the time of launch.

#### 2.4.2.8 Operational Hazard Areas

Vehicles that malfunction during the minus count and the early stages of flight endanger Land areas around the launch pad. Sea areas are similarly endangered by non-nominal vehicles and by the impact of spent stages from nominal vehicles. SEO identifies the endangered areas, quantifies the associated risks, and implements procedures to, where practicable, limit access of people, ships, and aircraft. Notice to Airman and Mariners, defining the affected areas, are published in hazardous area notices, and the function of the Surveillance Control Officer is directed toward reducing the traffic subject to risks in these areas.

##### 2.4.2.8.1 Flight Hazard Area

The Flight Hazard Area (FHA) is a ground area determined by SEO analysts and based on calculated explosive velocities, TNT equivalents, and overpressure from malfunction of a vehicle on the launch pad or in the early phase of flight. The area is drawn as a circle around the launch pad extending to an unlimited altitude (a cylinder), and includes the entire area where the risk of serious injury, death, or substantial property damage is so severe that it necessitates exclusion of all personnel and equipment not needed to support the launch operation (non-essential personnel). Personnel required to be in the FHA during launch must be located in blast-hardened and approved structures. An example of a FHA is shown in Figure 2-3.

##### 2.4.2.8.2 Flight Caution Area

The Flight Caution Area (FCA) is a controlled hazardous ground area, described by SEO, located outside the Flight Hazard Area that cannot be protected from a malfunctioning vehicle. The blast effects, described above, will propagate farther as the vehicle rises and programs downrange, exposing more land area around and under the trajectory between the pad and the ocean. The absence of early and accurate tracking data and the sum of the processing and display delays, plus the MFCO reaction time, are factors in the size and shape of the Flight Caution Area. The FCA is restricted to only mission-essential personnel during launch operations. An example of a FCA is shown in Figure 2-3.

##### 2.4.2.8.3 Launch Danger Zone

The Launch Danger Zone (LDZ) is a sea and air space extending from the launch point downrange, centered along the intended launch azimuth for a specified distance (typically 50 nautical miles). The size (length and width) of the LDZ is based upon the potential hazard to sea traffic. SEO provides the charts to plot targets and probability contours to show the risks to boats and ships in and approaching the Launch Danger Zone. Launch can be delayed if individual or combined risks to shipping are determined to be greater that $1 \times 10^{-5}$ from launch area boat and ship hit contours. Notices to Airmen and Mariners (NOTAMS, NTMs) are issued defining the areas and associated airspace for sea and air traffic. Vessels and aircraft are advised to remain clear of these areas during the specified time. In addition, copies of ER's hazardous areas are furnished to the US Coast Guard marine safety office in Jacksonville, FL, for distribution to the Port Canaveral Coast Guard station and other marine interests in the Cape Canaveral area.

#### 2.4.2.8.4 Spent Stage and Reentry Body Impact Areas

In addition to the areas that are endangered by a malfunctioning vehicle, there are areas where spent stages and reentering bodies from normally-performing vehicles will impact close enough to the launch pad that surveillance of the impact area can be performed by radar and aircraft from the CCAS. The Surveillance Control Officer monitors this area. In other cases, the impact areas are located too far out for land or air surveillance. Notices to Mariners advise sea traffic to remain clear of the defined impact areas for the time period specified in the notice. The hazardous impact area is a box enclosing the three-sigma impact ellipse.

#### 2.4.2.8.5 Hazardous Area Notices

SEO sends a letter to 45 RANS/DOUS (Range Scheduling) defining the hazardous areas for each launch. The letter gives the geodetic coordinates and distances for air and sea areas and the times that aircraft and vessels should remain clear of the areas. The letter also specifies the areas to be closed to unauthorized air traffic. The 45 RANS/DS sends NOTAMS and NTMs to all concerned agencies including foreign governments, if applicable. Figures 2-9 and 2-10 are plots of warning areas.

Designated aircraft control areas are:

- Restricted areas over CCAS and KSC (2932, 2933, 2934, and 2935);
- Warning areas (W-497A and W-497B).

SEO specifies the areas that should be activated for each launch operation.

#### 2.4.2.8.6 Collision Avoidance (COLA)

The COLA computer program is used to support space vehicle and ballistic launches where the trajectory of the launch vehicle and its components or stages could endanger an object capable of being manned. The purpose of the program is to ensure the safety of an orbiting, manned spacecraft against collision with a vehicle being launched. Inputs to the COLA program include a trajectory of the launch vehicle; an element set of the orbiting vehicle and miss distance desired. The trajectory of the launch vehicle is computed from vectors and required time intervals supplied by SEO. The element set of the orbiting vehicle is usually received from NORAD. More accurate element sets for STS launches can be obtained from Johnson Space Center. The trajectory and the element set are input to the COLA program that computes the closest approach of launch vehicle and orbiting spacecraft.

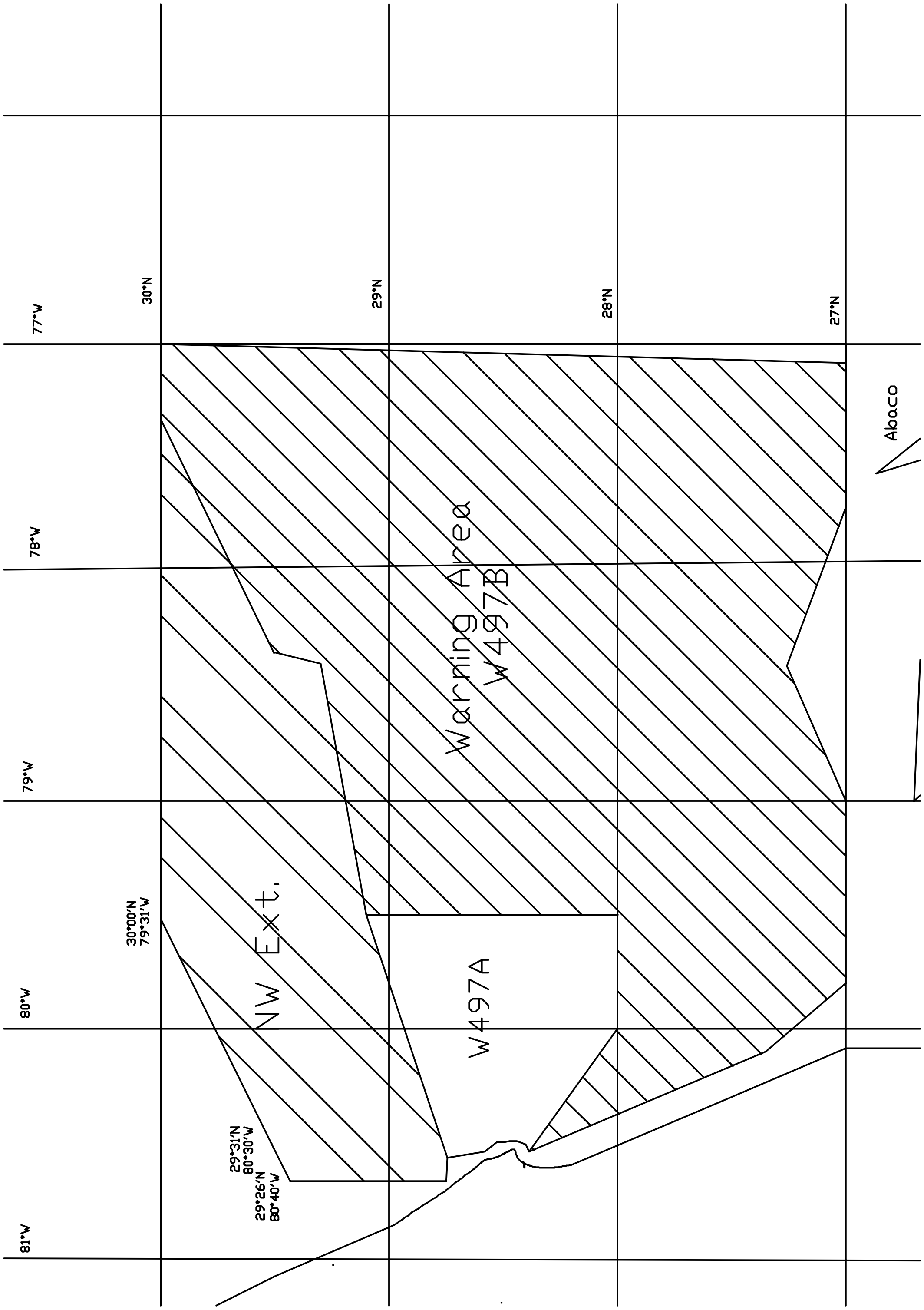



**Figure 2 - 9: Example of Offshore Warning Areas**

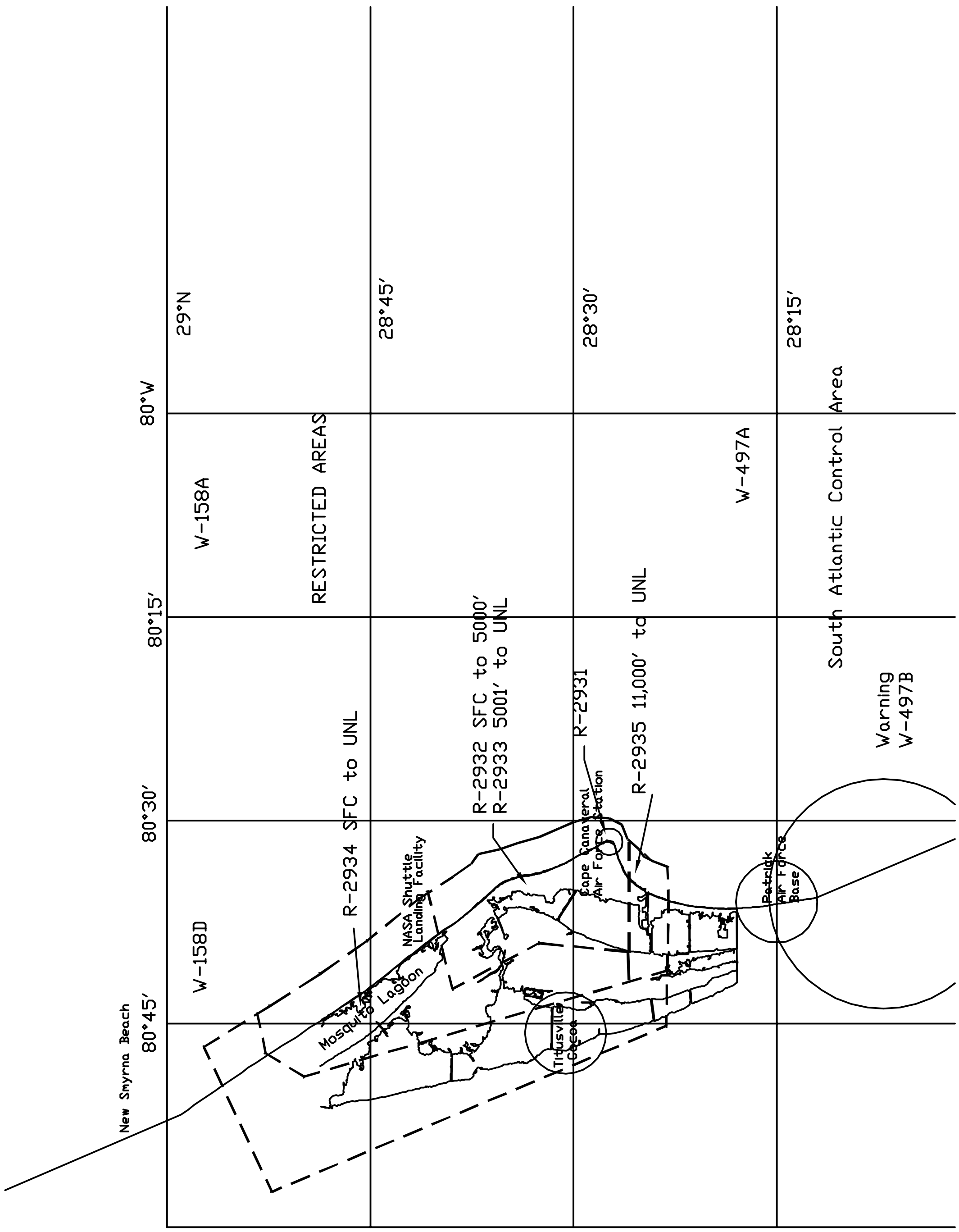



**Figure 2 - 10: Example of Launch Area Restricted Areas**

COLA provides Range Safety information to ensure that any launch from the ER comes no closer than specified distances to manned spacecraft. The parameters used by SEO are that the separation from a manned spacecraft is 200 kilometers. The COLA computed no-launch intervals are extended to account for uncertainties in the launch-vehicle trajectory and for possible maneuvers by the manned spacecraft.

## 2.4.3 Non-Compliance with Range Safety Requirements

Deviations or waivers to EWR 127-1 may be allowed when mission objectives cannot otherwise be achieved. These will be granted only under unique or compelling circumstances. The ER policy is to avoid the use of deviations or waivers except in extremely rare situations. Range Users are responsible for identifying all non-compliance's with this document to Range safety for resolution. Range safety and the Range user shall jointly endeavor to ensure that all requirements of this document are met as early in the design process as possible to limit the number of required deviations and waivers to an absolute minimum. Non-compliance items and their processing are explained in detail in Section 1.6.5 and Appendix 1C of EWR 127-1.

### 2.4.3.1 Types of Non-Compliance (The Section is being revised as part of CSWG)

#### 2.4.3.1.1 Deviations

Deviations are used when a design non-compliance is known to exist prior to hardware production or an operational non-compliance is known to exist prior to beginning operations at the Ranges.

#### 2.4.3.1.2 Waivers

Waivers are used when, through an error in the manufacturing process or for other reasons, a hardware non-compliance is discovered after hardware production, or an operational non-compliance is discovered after operations have begun at the Ranges.

#### 2.4.3.1.3 Meets Intent Certification

Certifications (MICs): MICs are used when Range users do not meet exact EWR 127-1 requirements but do meet the intent of the requirements. Rationale for equivalent safety shall be provided. MICs are normally incorporated during the tailoring process.

### 2.4.3.2 Categories of Non-Compliance

#### 2.4.3.2.1 Public Safety

Public safety non-compliance deals with safety requirements involving risks to the general public of the US or foreign countries and/or their property. Only the Wing

Commander or his/her designated representative shall approve a non-compliance affecting Public safety.

##### 2.4.3.2.2 Launch Area Safety

Launch area safety non-compliance deals with safety requirements involving risks that are limited to personnel and/or property on CCAS and may be extended to KSC. Launch area safety involves multiple commercial users, government tenants, and/or squadrons.

##### 2.4.3.2.3 Launch Complex Safety

Launch complex safety non-compliance deals with safety requirements involving risk that is limited to the personnel and/or property under the control of a single commercial user, full time government tenant organization, or USAF squadron/detachment commander (control authority). Launch complex safety is limited to risks confined to a physical space for which the single control authority is responsible.

#### 2.4.3.3 Effectivity of Non-Compliance

##### 2.4.3.3.1 Lifetime

Lifetime MICs are allowed provided equivalent safety is maintained. When granted, deviations and waivers are normally given for a defined period of time or a given number of missions until a design or operational change can be implemented. Lifetime deviations and waivers are undesirable.

##### 2.4.3.3.2 Time Limited

Time limited deviations and waivers are set for a limited period of time or a limited number of launches. The time constraint is normally determined as a function of cost, impact on schedule, and the minimum time needed to satisfactorily modify or replace the non-compliant system or to modify the non-compliant operation. MICs may be time limited depending on the method by which equivalent safety is accomplished. If excessive procedural controls, personnel, material, or costs are required to maintain equivalent safety, the MIC should be time limited.

#### 2.4.3.4 Conditions for Issuing Non-Compliance

##### 2.4.3.4.1 Hazard Mitigation

All reasonable steps shall be taken to meet the intent of EWR 127-1 requirements and mitigate associated hazards to acceptable levels, including design and operational methods.

#### 2.4.3.4.2 Get Well Plans

All MICs, deviations, and waivers that are not granted for the life of a program shall have a plan to meet the requirements in question by the time the approved effectively expires.

#### 2.4.3.4.3 National Need Rationale

Rationale for national need or mission requirements shall be explained.

### 2.4.3.5 Submittal of Non-Compliance

#### 2.4.3.5.1 Submittal Format

All non-compliance items shall be submitted in writing in letter or memorandum format or the equivalent. An example format may be found in the Range User Handbook. The details for content of a non-compliance request are discussed in EWR 127-1 Section 1C.2.2.

#### 2.4.3.5.2 To Whom Submitted

Requests for MICs, deviations, and waivers shall be submitted to the Office of the Chief of safety as early as they are known to be necessary.

#### 2.4.3.5.3 MICs, Long Lead Time Submittals

Deviations, and waivers such as those including flight plan approval, flight termination system design, and toxic propellant storage normally require extensive risk analyses that can take one to two years to perform; therefore, these deviations, MICs, and waivers shall be initiated during the planning phase and be closed out by Range approval or design change prior to manufacture of the booster, spacecraft, flight termination system or other system in question.

#### 2.4.3.5.4 Submittals for Launch Site Safety and Launch Complex Safety

Launch site safety and launch complex safety MICs, deviations, and waivers normally require two weeks to two months to process depending on the nature of the non-compliance and the requested effectively.

## 2.4.4 Reviews

System Safety (SES) must be notified of all System Requirements Reviews (SRRs), System Design Reviews (SDRs), Preliminary Design Reviews (PDRs), Critical Design Reviews (CDRs), Phase Safety Reviews, or any system/program concept meetings involving safety critical systems, hazardous operations, and facility design/modifications so that Range Safety input can be incorporated.

#### 2.4.4.1 Range User/Range Safety Interface Process

This section covers the range user/Range Safety interface process used to ensure that only those portions of EWR 127-1 that are directly applicable to a given program's specific needs are emphasized, and that both Range Safety and the range user understand the requirements and reach mutual agreement on compliance methods early in the program.

The interface process must commence during the concept phase of a program in order to ensure early Range Safety participation and resolution of safety issues. Time line and event schedules will vary depending on the complexity of the program. Figure 2-11 provides a general schedule and time line of events as guidance for major launch vehicle programs. For small vehicles, these time lines can be compressed down to approximately one year or less, depending on whether new or previously approved hardware is involved. Spacecraft and satellite time line and event schedules differ significantly from launch vehicles and are covered in the following section and in Figures 2-12 and 2-13.

##### 2.4.4.1.1 Initial Interface

Potential range users may make initial contact with Range Safety prior to officially submitting a program introduction document. It is recognized, particularly for commercial programs, that initial contact with Range Safety may be necessary during the commercial booster/payload customer contract negotiations. The purpose of these meetings is to clarify program concepts, determine whether specific flight profiles can be accommodated, and to determine whether there are any major safety concerns which could impact the program.

##### 2.4.4.1.2 High Performance Work Team

Once a Program Introduction has been accepted by the range, Range Safety initiates a meeting with the prospective range user to establish a High Performance Work Team (HPWT). When the user decides and officially notifies the range that they will use the ER, the work team is activated. The goal of the HPWT is mutually acceptable, tailored requirements. In those situations where mutual agreement is not achieved, an appeal to the next level of ER organizational responsibility is heard. The appeal channels follow the management and functional organizational arrangement. The team's task includes the following:

- Definition and identification of all hazardous systems associated with launch vehicle and/or payload (spacecraft);
- Description of vehicle flight path in terms of azimuth and trajectory;
- Definition of launch vehicle configuration, performance characteristics, and program mission requirements;

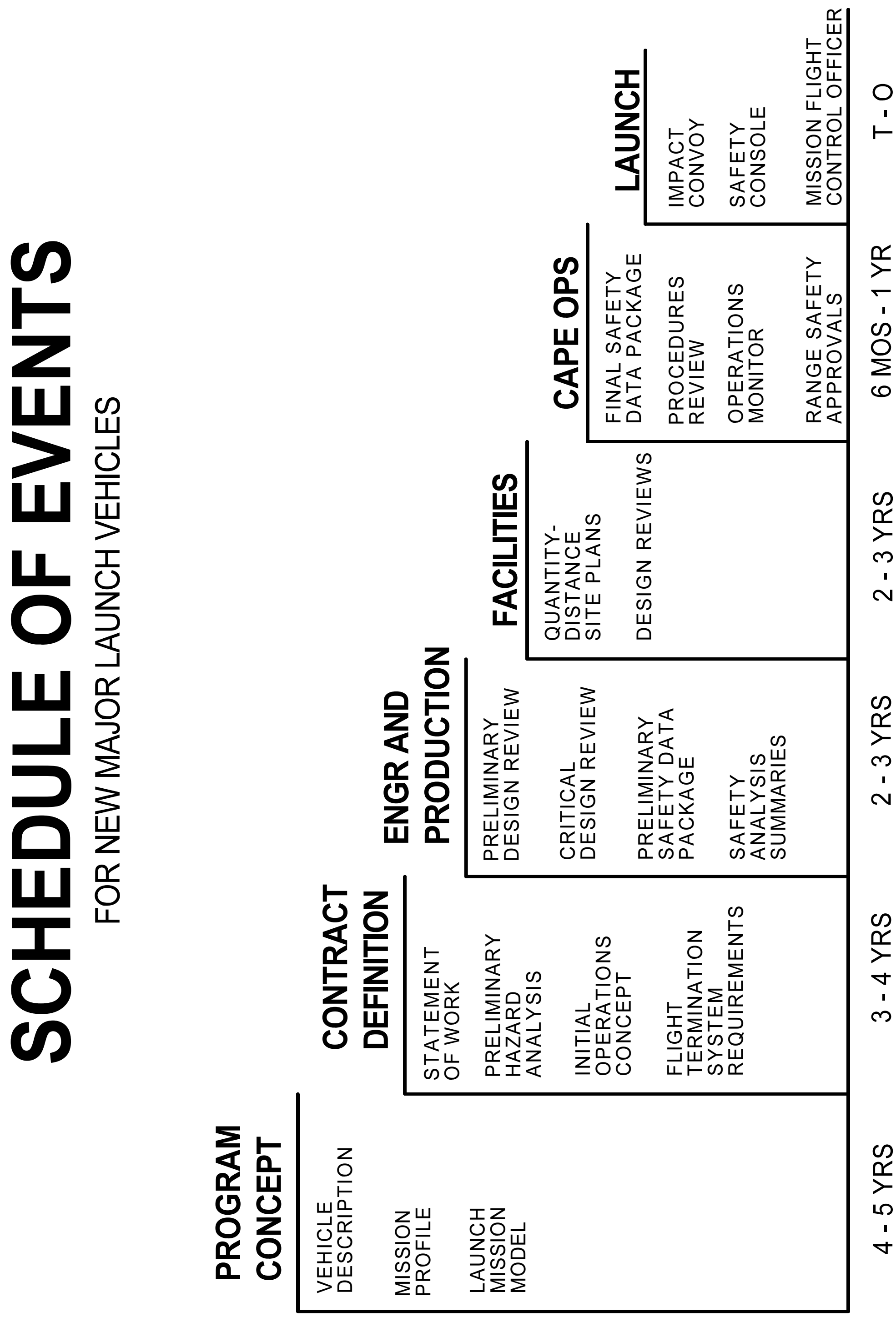



**Figure 2 - 11 Schedule of Events**

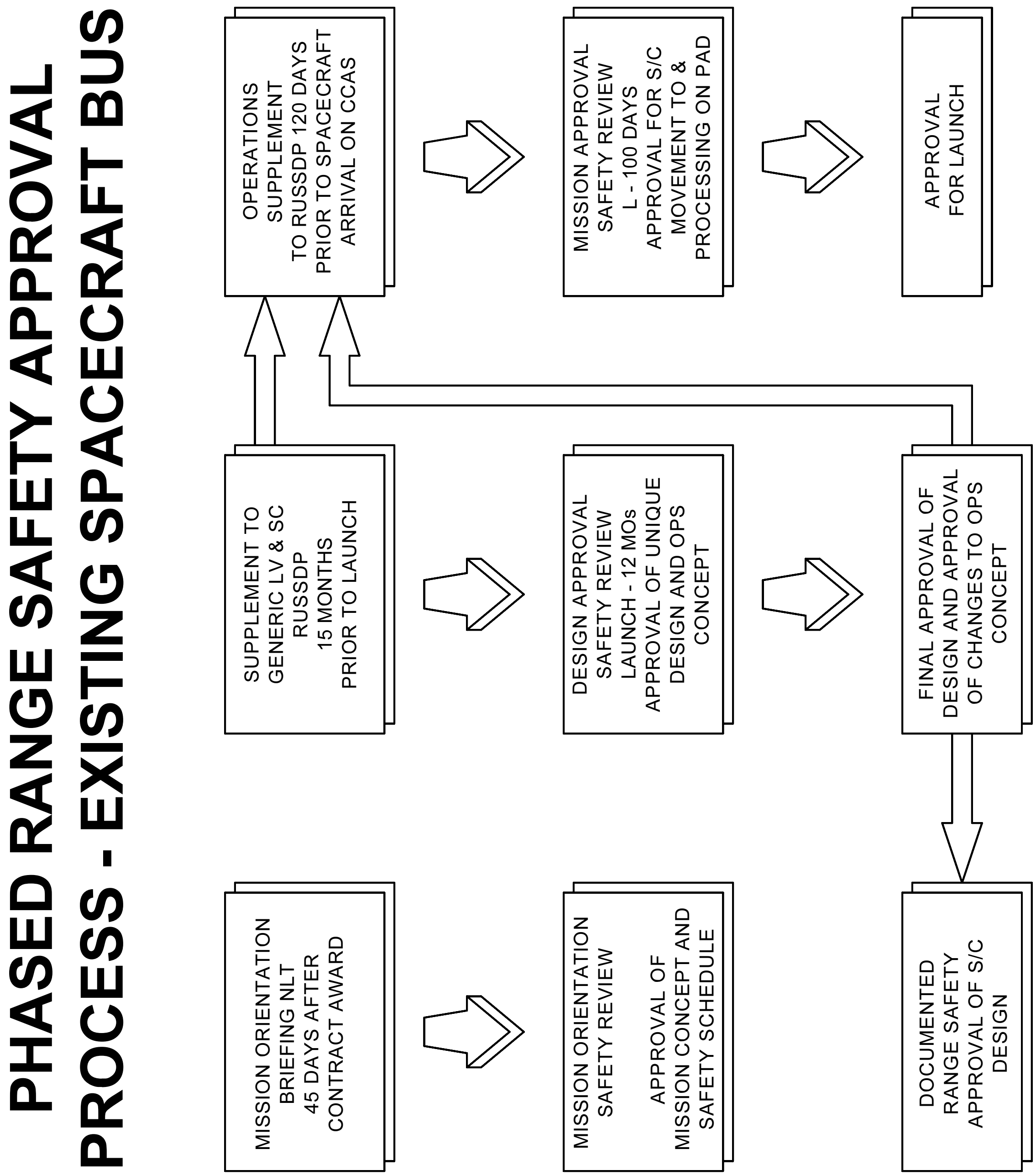



**Figure 2 - 12: Phased Approval for Existing Spacecraft Bus**

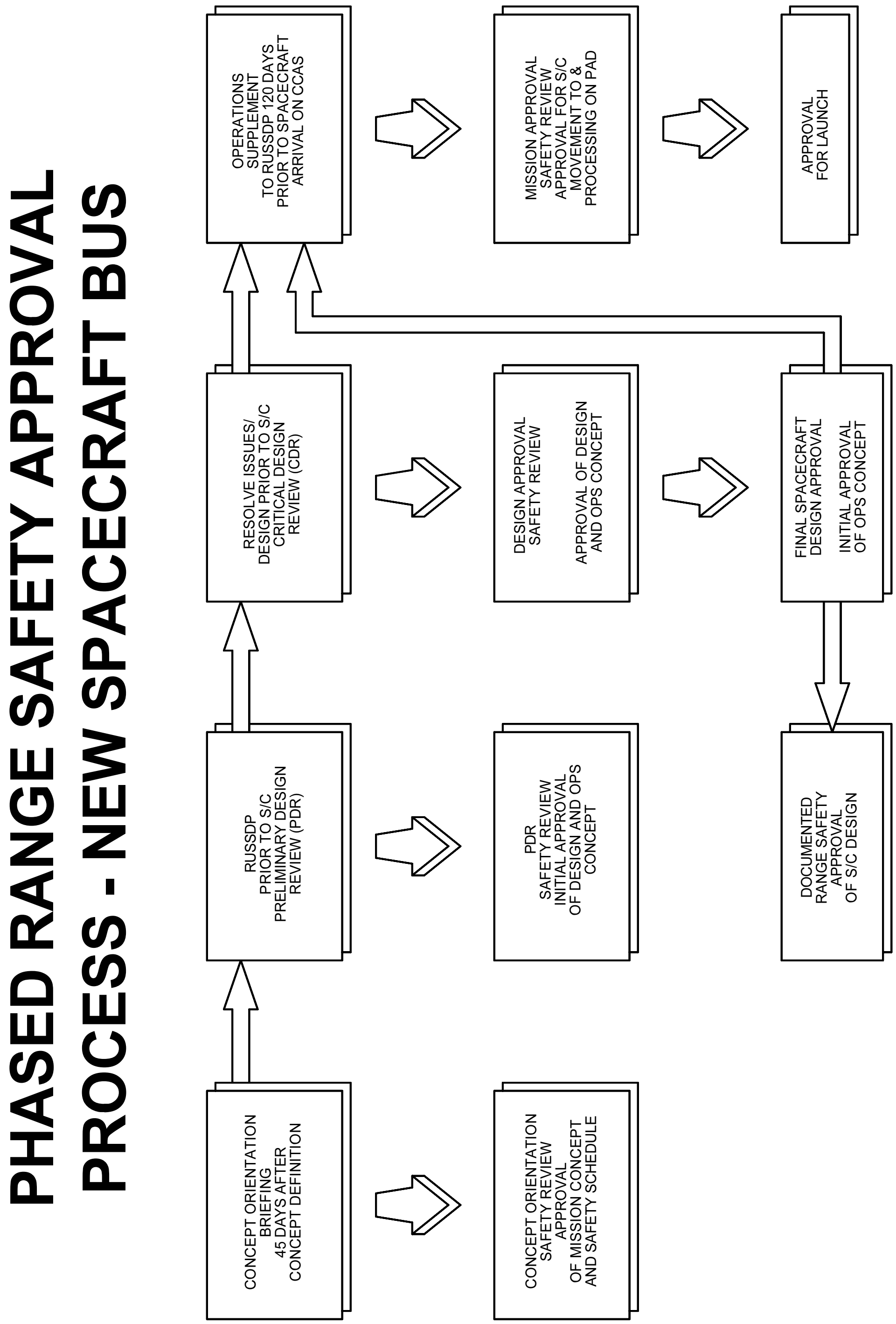



**Figure 2 - 13: Phased Approval New Spacecraft Bus**

- Failure modes and failure probabilities of the launch vehicle and/or payloads;
- Definition and description of facilities required, including launch complex, hazardous assembly and checkout areas, and ordnance and propellant storage requirements;
- Based on the results of the initial HPWT evaluation, each chapter of EWR 127-1 is tailored to specific requirements for the mission. The tailoring effort progresses and becomes more detailed as program definition phase moves from concept through preliminary and critical design reviews. The HPWT establishes a documented EWR 127-1 tailored baseline, which is used throughout the life of the program and is modified as new data is available and modifications are made. The baseline documents each EWR 127-1 requirement;
- Documentation is maintained by the team regarding agreements, problem issue closeouts, waivers, deviations, and 'meet the intent' decisions.

Membership on the High Performance Work Team includes Range Safety representatives responsible for flight termination system design, flight plan approval, destruct criteria development, system safety, and facilities design. Depending on size and scope of the mission and/or the program, Range Safety membership can range from one to four individuals. The range user is requested to provide participants who are familiar with, and responsible for, development of the FTS, launch vehicle and payload configuration, vehicle performance characteristics, failure modes, breakup parameters, operational flow process, facility requirements, and launch vehicle hazardous systems. This could require participation from three to ten individuals from the user organization. Each new program is defined from the concept phase through the critical design review, and includes the following:

- Complete vehicle description, including number of stages, type of propellants, payload (spacecraft) description, type of guidance system, and planned number of launches;
- Vehicle performance and mission characteristics;
- Planned launch azimuth and trajectories are provided in a preliminary form as soon as possible and modified as more detail is available. Vehicle thrust and weight ratios, and acceleration parameters are defined;
- Turn rates, Q, malfunction time, and breakup characteristics are developed and defined. Breakup characteristics based on failure modes and failure probabilities are developed;
- Vehicle flight plans are defined in terms of azimuth and trajectory, acceleration and velocity, and identification of landmass overflight;
- Requirement for risk assessment is defined, and schedules developed to determine need dates;
- Destruct criteria, mission rules, and FTS requirements are defined, and FTS requirements are tailored to meet specific programs. The tailored version will be used in the design, qualification and acceptance tests, data submittals, and Range Safety review and approval.

#### 2.4.4.2 Generic Spacecraft Approval Process

The phased Range Safety approval process shown in Figure 2-13 is used for new spacecraft and satellite buses. The goal is to grant baseline approvals for generic buses during the first mission. Subsequent flights will use a joint assessment process (Range Safety, spacecraft manufacturer, and launch vehicle company) to review and approve changes to the generic bus and/or payload additions for specific missions. Using the approval process outlined in Figure 13, the following process and time line guidance is provided.

- A concept orientation briefing is provided to Range Safety early in the conceptual phase of the development. The generic approval process is documented and concept approvals granted so that an audit trail can be established. A concept orientation safety review is held in conjunction with this briefing and approval of design concepts, schedule of safety submittals, and Range Safety responses are documented. Range Safety concept approvals not granted at this meeting will be provided within 10 working days.
- A Preliminary Design Review is held at least 12 months prior to scheduled launch and serves to provide necessary data for the initial Range Safety approval before the final spacecraft design and prelaunch processing is initiated. Range Safety provides approvals within 30 working days after the meeting.
- A Critical Design Review is held prior to initiating hardware manufacture. This review provides Range Safety the necessary data to grant final design approval and prelaunch processing initial procedure review. Range Safety will provide response within 30 working days after the meeting.
- A mission approval safety review is conducted approximately launch minus 120 days to obtain Range Safety approval for booster processing, transport to the spacecraft launch pad, spacecraft/launch vehicle mating, and launch pad spacecraft processing. Unless there are significant issues, Range Safety will provide mission safety approval ten working days after the safety review.
- Final approval to proceed with launch vehicle and spacecraft processing up to commencing the final countdown is provided by Range Safety at least 60 days prior to spacecraft arrival at the launch complex. Flight plan approval for a high inclination launch that involves public safety may require extensive risk analyses and may not be granted until just prior to the Launch Readiness Review, depending on the complexity of the public safety issue encountered. Typically, easterly launch azimuths can be approved very early (at least 120 days prior to launch).
- Incidental Range Safety issues (component failures, test failures, and discovery of unforeseen hazards) occurring following baseline approvals, are worked in real-time as part of the final approval process for an individual launch. Typically, these issues involve the launch vehicle, not the spacecraft.
- Additional response time for Range Safety will be required if data packages are incomplete, complex issues are uncovered, or data is poorly presented.

## 2.4.5 Range Safety Launch Operations

This section contains Range Safety policies, identifies requirements, and provides procedures used by 45 RANS/DOOC Mission Flight Control Officers (MFCO's), acting for the Eastern Range Launch Decision Authority (LDA) in the execution of the flight safety program.

### 2.4.5.1 Range Safety Operations Responsibilities

The MFCO is responsible for in-flight safety that includes taking all necessary precautions to minimize the risks to life and property, while not unduly restricting a non-nominal vehicle that has not violated flight termination criteria. Air Force officers and DOD civilians serve as MFCOs. In addition to the two MFCOs manning the safety console in the Range Operations Control Center (ROCC), there are supporting MFCOs at the vertical wire skyscreen, telemetry console, command console, and at the Surveillance Control Officer position. Additional MFCOs may be on board ships and in helicopters or aircraft as required.

The capability to ensure launched vehicles do not violate approved flight rules is imperative for the public safety; therefore, the primary responsibility of the MFCO is to monitor the progress of a launched launch vehicle or space vehicle and determine if its flight should continue or be terminated. The MFCO will normally take flight termination action under the following conditions.

- Obviously Erratic Flight - Vehicle performance is such that the potential exists for loss of flight termination control as the result of a gross flight deviation or obviously erratic flight, and further flight is likely to increase the hazard potential. This action may be taken even though the launch vehicle has not violated the flight termination lines.
- Flight Termination Line Violation - Valid data show that the launch vehicle flight violates a flight termination line.
- Performance Unknown - Launch vehicle performance is unknown and the capability to violate a flight termination line exists. If launch vehicle performance has been normal after launch for an extended period of time prior to becoming unknown, the MFCO, after consultation with the Senior MFCO, may allow the flight to continue.
- Mission Rules - At the request of the range user.

Flight termination, for liquid-fuel boosters, consists of fuel cutoff (arm command) followed by destruct (destruct command). In some cases, such as the range user's requirement to collect as much data as possible, destruct action may not be required after engine shutdown (thrust termination) has been confirmed, and impact of the vehicle is calculated to be in the broad ocean area. For solid-propellant boosters, there is no means to terminate thrust except to send the destruct command.

#### 2.4.5.2 Clearance

Launch area surveillance encompasses those land, air, and sea areas designated as the Flight Caution Area and Launch Danger Zone for a launch. The MFCO ensures that these areas are clear or that the probabilities of being hit by debris or exposed to overpressure are within acceptable limits for aircraft, surface vessels, and personnel within these areas. This determination is made prior to giving a "MFCO GO". The Operations Safety Manager is responsible for clearing the Flight Caution Area and reporting the area clear to the MFCO. This report is made at a designated time in the launch countdown.

Warning signals are displayed (i.e., Sign in the Port area) when the Launch Danger Zone is closed at L-60 minutes. In addition, marine radio broadcast warnings are broadcast on NOAH weather frequencies to inform vessels of the effective closure times for the sea Launch Danger Zone.

Control of air traffic in Federal Aviation Administration-designated areas around the launch head is maintained by coordination between the Surveillance Control Officer, the Aerospace Control Officer, and Miami and Jacksonville Air Route Traffic Control Center (ARTCC) to ensure that aircraft are not endangered by launches, nor launches delayed by the presence of aircraft. The Military Radar Unit located at the Range Operations Control Center (ROCC) CCAS, Florida monitors airspace and is in communication with Miami and Jacksonville air traffic control.

#### 2.4.5.3 Surveillance

Fixed wing aircraft support for surveillance control is normally required for STS launch operations and may be required for other unique launches. Aircraft must be available for the duration of the launch window and are controlled by the Surveillance Control Officer (SCO) during surveillance operations.

One or more helicopters are normally required to perform sea surveillance of the Launch Danger Zone for all launches from CCAS and KSC. They are also used, when possible, to support offshore launches. The helicopters are available for surveillance operations no later than L-90 minutes prior to launch.

The RAPCON radar at Patrick AFB and the Jacksonville and Miami ARTCC radars are used to support pad and offshore launches. They provide surveillance for intruding aircraft within a 50 nautical mile radius of the launch point, beginning no later than L-30 minutes and continuing until released by the SCO. Contacts are reported by speed, heading, and bearing from a known reference point, and estimated time to clear the warning areas. In addition, the FURUNO radar is used for sea surveillance during pad launches. They are available from L-120 minutes until released by the SCO.

Launch area surveillance charts and ship/boat contours used for SCO plotting are provided by SEO (see Figures 2-14 and 2-15). During launch operations, the SCO displays any reported surface vessel and support aircraft positions on the surveillance plotting board. Communications links between the SCO and the MFCO, ACO, surveillance radar operators, supporting surveillance aircraft, and the US Coast Guard Station (USCG), Port Canaveral, are required.

USCG support includes:

- periodic warning broadcasts no later than L-4 hours, repeated every hour until T-0, to advise vessels to remain clear of the Launch Danger Zone;
- at least one USCG patrol vessel positioned at the entrance to Port Canaveral, no later than L-60 minutes, to warn other vessels leaving the port to remain clear of the Launch Danger Zone;
- marine radio communications capability to contact endangered vessels, warn them, and provide instructions for clearing or avoiding the Launch Danger Zone; and
- a liaison officer in the SCO area to coordinate USCG support on launch day.

#### 2.4.5.4 Weather

For all major launches from CCAS and KSC, the Cape Canaveral Forecast Facility (CCFF) provides the SEO representative assigned to the launch with a forecast of launch winds on F-1 day, on launch day, and at other times during the launch when requested. In developing wind forecasts, the latest available balloon data and met-rocket data are combined to produce the best possible estimate of T-0 winds. After the wind forecast has been established on disk file, a CCFF meteorologist discusses the degree of confidence in the predicted winds with SEO personnel. The likelihood of any changes in wind speed or direction before the launch, and the magnitude of any such changes, is also discussed. As a result of this briefing, SEO determines whether additional wind observations will be required. If the wind forecast should subsequently change because of launch delays or other circumstances, the meteorologist informs the MFCO and SEO representatives immediately. Estimates of quantitative changes in wind speed and direction as a function of altitude is provided. At L-60 minutes, the CCFF provides a weather forecast briefing for the launch area using closed circuit television and direct line or network communications.

In addition, there are two computer programs that use current data to predict whether the weather is suitable for launch.

- BLAST is a program that uses current weather to determine whether certain meteorological conditions are suitable for launch or could cause catastrophic overpressures in the event destruct action is necessary.

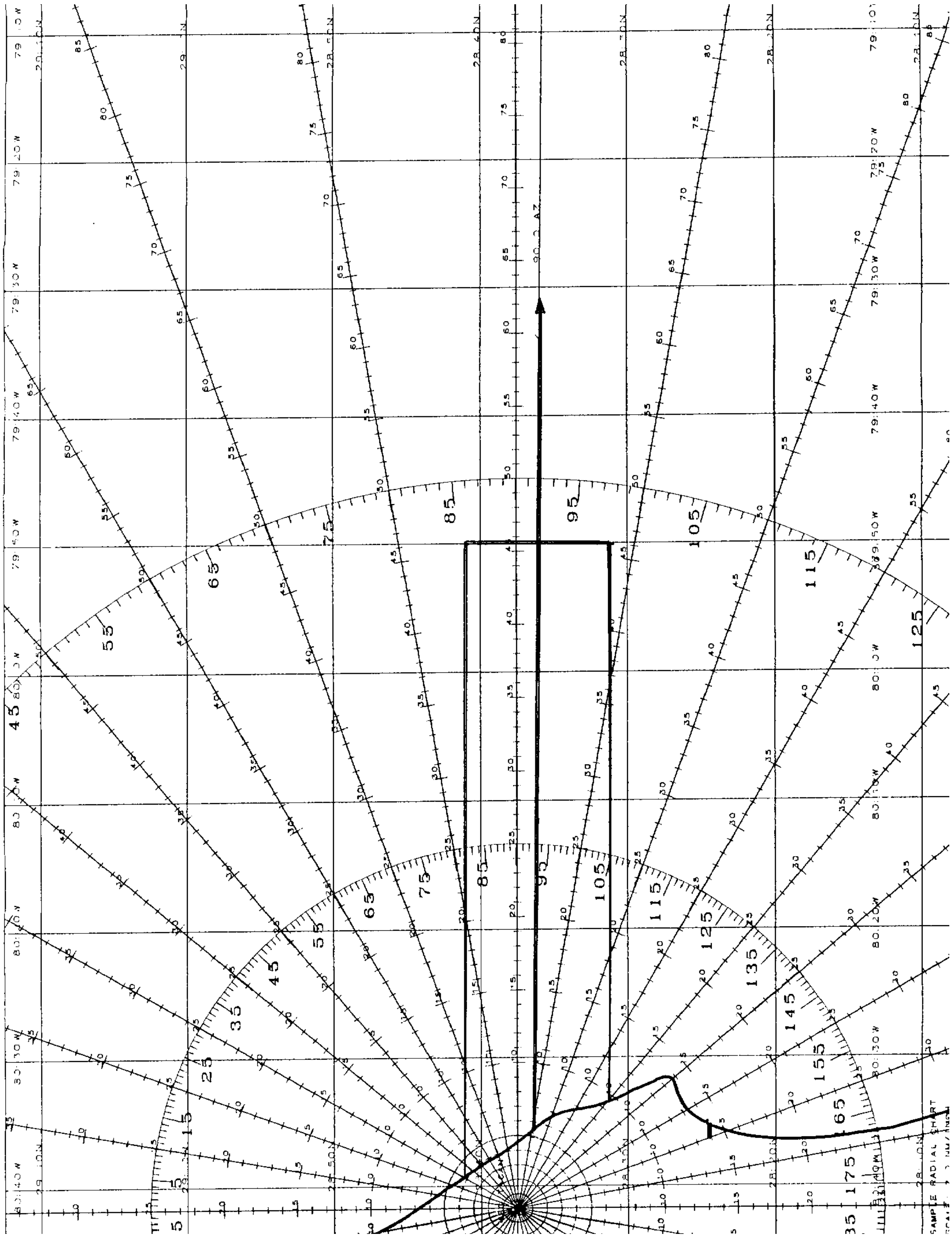


**Figure 2 - 14: Example of SCO Plotting Chart**

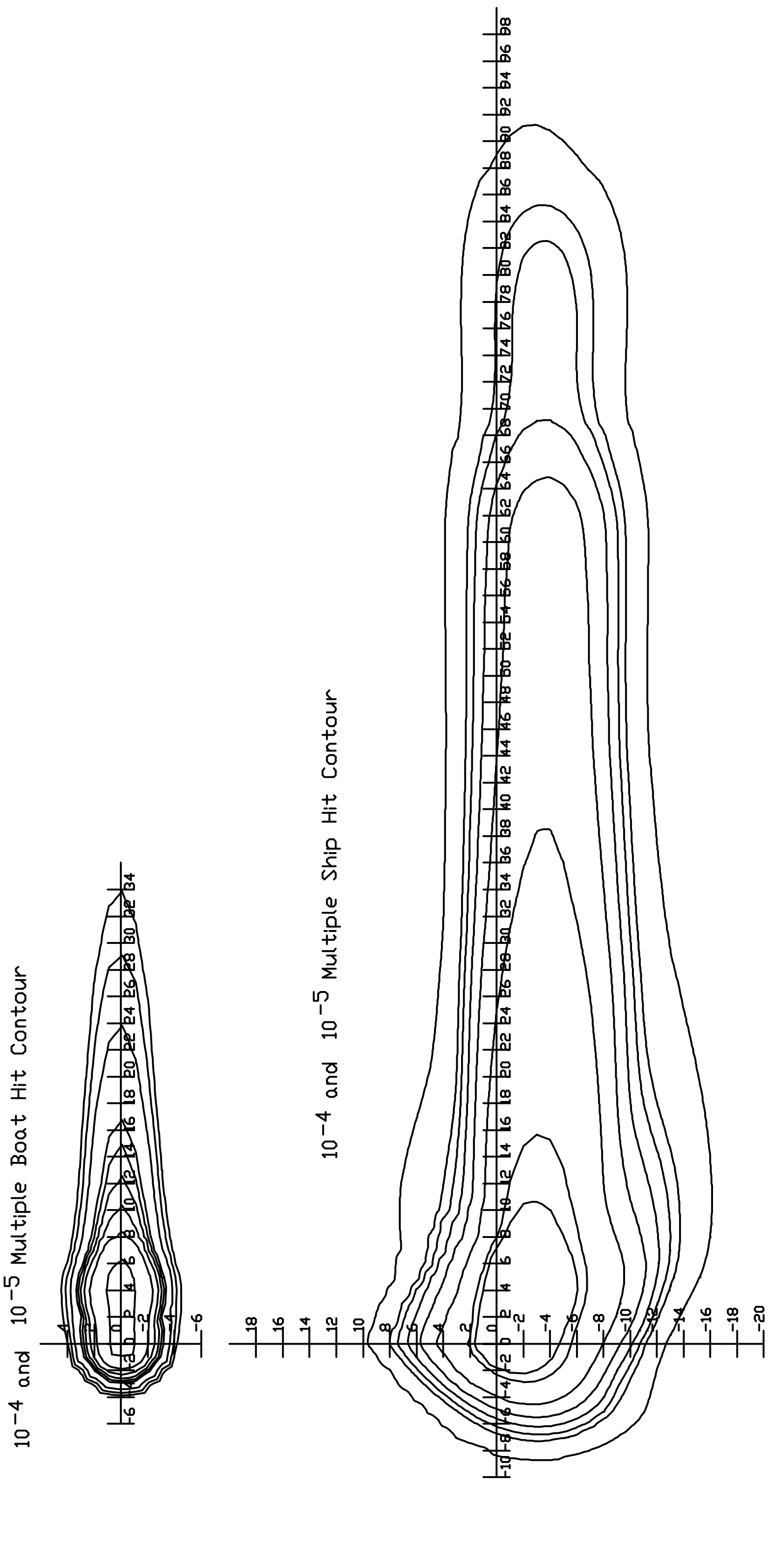



**Figure 2 - 15: Example of Multiple Boat/Ship Contours**

- Eastern Range Dispersion Assessment System (ERDAT) is a system that uses current weather data to determine the downwind diffusion prediction in the event of a toxic release.

### 2.4.5.5 Range Safety System

The Range Safety System consists of all equipment, software, and personnel required performing the Range Safety function for an operation. The MFCO must either be in position to see the data displays or be in communication with support personnel who are observing the data. The information must be presented in a format that is simple to evaluate, available in a timely manner, and communicated such that the MFCO is not over-saturated with data.

#### 2.4.5.5.1 MFCO Console

The MFCO console has six high-resolution color monitors, video monitors, communication and timing panels, and flight termination switches. The console has two operating positions, one for the MFCO and one for the Senior Flight Control Officer. Each MFCO can independently select the data and display to monitor throughout flight.

#### 2.4.5.5.2 Instrumentation

Range instrumentation data sources provide the MFCO with real-time information on launch vehicle behavior. Instrumentation is designed to ensure that no single-point-of-failure, hardware or software-related, will deny the MFCO the capability to directly monitor a launched vehicle's flight. When possible, Range Safety critical instrumentation is designed to allow single failures in hardware, and still provide overall system redundancy. Track from at least two adequate and independent data sources is mandatory and will be maintained throughout each phase of powered flight or until orbital insertion of the vehicle. An analysis is done to help the MFCO know if the vehicle has reached the no-longer-endanger (NLE) line. The NLE for suborbital missions is defined as the time or position on the nominal trajectory at which the vehicle no longer has sufficient energy to endanger areas outside the impact limit lines. After the NLE is reached, destruct action is not required if track is lost. For orbital missions, which typically involve overflight of land shortly before orbital injection, it is customary to establish a gate in the destruct line through which the vehicle's impact trace must pass to avoid destruct action. The NLE is defined as the time in flight when the time required for the impact point to travel along the nominal trajectory to the overflight gate is less than the travel time to all other points along the boundary lines. If the vehicle arrives normally at the NLE, and track is subsequently lost, no destruct action is taken. Withholding destruct in such cases assures that a vehicle will not be intentionally destroyed while the impact point is traversing land or the vehicle is in orbit.

#### 2.4.5.5.3 Range Tracking System

EWR 127-1 requires a Range Tracking System (RTS) that is comprised of the hardware, software, and manpower required to transmit, receive, process, and display launch vehicle data required for Range Safety purposes. An RTS, including at least two adequate and independent instrumentation data sources, is mandatory and shall be maintained from T-0 throughout each phase of powered flight up to the end of Range Safety responsibility.

#### 2.4.5.5.4 Vertical Wire Skyscreen

A Vertical Wire Skyscreen (VWSS) sighting apparatus, manned by a Forward Observer will be required for all pad launches. Range contractor technicians must complete the leveling and alignment of this apparatus no later than L-60 minutes.

Flight line and program television skyscreen systems are also required for all pad launches and are placed in operation no later than L-45 minutes. The program camera is fixed in azimuth, but free to track in elevation. A vertical reference line and arrow indicating planned direction of flight is superimposed on the TV transmission to monitors at the MFCO console positions.

#### 2.4.5.5.5 Telemetry

The MFCO is also presented with real-time vehicle performance and impact prediction data derived from telemetry. Real-time telemetry of launch vehicle guidance data (state vector), if available, is used to generate an impact point for the MFCO. Specific telemetry display requirements are listed in the Range Safety Operations Requirements document (i.e., vehicle chamber pressure, roll, pitch, and yaw, and FTS status). The only specific telemetry requirements that apply to all vehicles are the FTS status requirements. On request, 45 SW/SEO and RANS/DOOC are provided calibration data on the demodulated, telemetered performance of a launch vehicle by the range user.

#### 2.4.5.5.6 Displays

The range contractor is responsible for the computation of solutions for present position and impact position and their display to the MFCO. The computation and display must be single failure tolerant. The prime displays are derived from range radar data and the alternate displays are derived from vehicle guidance state vector. Radar trilateration solutions are also required when available, however, this is not a hard requirement.

#### 2.4.5.5.7 Functional Check

A complete end-to-end check of the Range Safety systems used to display data for flight control to the MFCO is made during the countdown using taped data, supplied by SEO no later than F-5 days, to simulate inputs from range radar, other tracking sources, and vehicle telemetry data. This functional check does not relieve the range contractor of responsibility for proper operation of the system during a launch.

#### 2.4.5.6 Command System

The Command System, also known as the Command and Control system, is the ground portion of the flight termination system used during launch operations. It is comprised of ground transmitters at various sites throughout the Eastern Range (Cape Canaveral Air Station, Jonathan Dickinson Missile Tracking Annex (JDMTA), Antigua, Bermuda, Wallops Island, Virginia, and Argentia, Newfoundland) and the subsystems that support them.

##### 2.4.5.6.1 Central Command Remoting System Operations Concept

During prelaunch preparation, the Central Command Remoting System (CCRS) is configured for the particular mission, using the configuration switches in the Command System Controller (CSC) configuration drawer and on the console. The FTU's are configured for the commands, such as setting Switch No. 1 as Arm and Switch No. 2 as Destruct. Autocarrier switch times are set, and supporting stations are configured on both the CSC and Range Safety Control and Display (RASCAD). After prelaunch checks are complete, no modifications to the switch settings are permitted.

During F-1 and launch day preparations, the CCRS is put through a complete system check. The CCRS supports all theoretical data runs, which includes bringing up the command carrier at the supporting command stations. Additionally, the CCRS performs switching checks with each supporting command station. These switching checks involve placing each of the CCRS Command Message Encoder Verifiers (CMEV's) and stations' subsystems online, radiating carrier, and modulating command functions.

After all prelaunch checks are complete; the key-lock switch in the CSC is set to lock out control from the CSC and turns over complete control of the system to the MFCO. From that moment on, only the MFCO's may turn on the carrier from RASCAD and request command functions from the FTU. The system will remain in that configuration until the CCRS has been released from the mission.

##### 2.4.5.6.2 Command Sites Operations Concept

The Cape Canaveral Air Station (CCAS) Command sites operate in either local mode or remote mode. In local mode, a site retains control of the command carrier and functions. This mode is used for local site checkout only and is never used for operations. When the station is ready to support the operation, the site is placed in remote mode. This mode allows the operation of the site carrier and functions to be remotely controlled by the CCRS. The operating frequencies of the carrier are 406.5 Megahertz (MHz) for testing and 416.5 MHz for operations.

During F-1 and launch day preparations, the CCAS Command Station supports all theoretical data runs. For the CCAS station, this includes driving the steerable antennas and having the command carrier on at the station during the planned time of the launch. Additionally, the CCAS station performs switching checks with the CCRS. These switching checks involve placing each of the station's subsystems (High Power Site 1A and 1B) with each CCRS CMEV online, radiating carrier, and modulating command functions.

After all prelaunch checks are complete; the station is placed in remote mode to lock out control by the station Operations personnel. Once in remote mode, site personnel are prohibited from returning to the Local mode by means of strict operational discipline. Complete control of the system is remoted to the CSC and MFCO. From that moment on, only the MFCO's may turn on the carrier from RASCAD and request command functions from the FTU's. The system will remain in that configuration until the station has been released from the mission.

#### 2.4.5.7 Launch Operations

Preflight, countdown, and inflight launch vehicle operations are as follows (launch operations of the Lockheed Launch Vehicle (LLV) is used as a typical example).

##### 2.4.5.7.1 Preflight Operations

During preflight operations, checkout of the command control system is completed by L-45 minutes. When these checks are completed, the Range Control Officer (RCO) confirms to the MFCO that the ground portion of the flight termination system is fully mission-capable. The MFCO then assumes full control of all command control systems. After the MFCO assumes control of the system, the Operations Safety Manager (OSM) will not allow the flight termination receivers to be turned on or off, and the RCO will not allow functions to be transmitted, without the specific approval of the MFCO. In case of misfire, hangfire, or mission scrubs, the receivers will be turned off in accordance with the appropriate checklist, which is developed by the range user and reviewed and approved by Range Safety.

The OSM provides the SES representative for the launch with results of launch vehicle flight termination system checks as soon as possible after they are conducted. The MFCO will not authorize launch until the SES representative confirms that the launch vehicle flight termination system is functioning properly. Proper operation of the flight termination system, as verified to and confirmed by the SES representative, includes the following:

- The command control system supporting a launch is checked out and is fully operational;

- The airborne flight termination system, when required, is checked out and is fully operational;
- All displays associated with the launch vehicle flight termination system and command control system are functioning properly at the MFCO console positions.

The OSM and /or the Operations Safety Technician (OST) are responsible for the following preflight action item requirements.

- To ensure proper operation, the holdfire and firing line interrupt capability is checked out at a mutually agreed upon time on the launch pad as close to launch as practical with Operations Safety present.
- Results of the checkout are reported by Operations Safety to the MFCO during the launch countdown.
- At the time specified in the countdown/pre-count, the OSM's must be on station at the Operations Safety Console in the blockhouse/Launch Control Center and at the launch area.
- The OSM is responsible for clearing all non-essential personnel from the Flight Caution Area during caution periods and for proper housing of essential personnel within the Flight Caution Area during danger periods.
- The OSM controls all warning devices provided to indicate caution and danger periods.
- The OSM declares caution and danger periods at the times such action becomes necessary in the interest of safety.
- At a mutually agreed upon point in the countdown, the OSM confirms to the MFCO that the Flight Caution Area is clear.
- The OSM initiates HOLDFIRE when safety constraints or emergency situations dictate.

#### 2.4.5.7.2 Countdown Operations

Documents published to govern launch activities include the Launch Countdown and the Launch Commit Criteria (LCC) – The Launch Countdown is generally published as one document, but may be published as Phase 1 and Phase 2. When published separately, Phase 1 of the launch countdown, details the work required, step-by-step, to prepare the vehicle from the start of the countdown at T-25.5 hours, to the final 'pad clear' at about T-4 hours; whereas, Phase2 of the Launch Countdown, describes the work steps performed from the launch van, or by the range for the final hours of countdown through launch. The LCC are employed throughout the countdown to identify the allowable criteria limitations for weather, launch vehicle, or spacecraft systems. During the countdown, all range safety actions will be performed consistent with mission rules for the program/vehicle.

Vehicles using liquid propellants start to flow fuel/oxidizer through the engines prior to T-0. In some cases, e.g. shuttle and atlas, the engines actually fire, build up thrust, and the vehicle is released at T-0. Once this process begins, a hold will result in a scrub for 48 hours or more while the lines are purged and the engines are flushed and the system is verified to be in proper working order, in a worst case scenario a fire or explosion could occur as the result of a last minute shutdown.

To avoid possible catastrophic events, a T-X time was implemented for liquid fueled vehicles. This time, identified by the range user and reviewed and coordinated with range safety (45SW/SES), becomes the time beyond which no hold shall be initiated by anyone for a Flight Control or Range Safety event.

Vehicles that only have solid propellants may also have T-X times to identify when an event occurs, short in the count, to isolate the vehicle from the hold-fire circuit. An identification and coordination cycle similar to that for the liquid powered vehicles is required.

(paragraph deleted)

<u>Current vehicles with T-X times:</u>
The Athena; Atlas IIA, IIAS; Atlas III; Atlas V9EELV); Delta II, III, IV; Shuttle and Titan IVB currently have coordinated T-X times between 0.7 and 11 seconds. These times reflect software and hardware constraints. These times are changed infrequently because of new or changing developments in flight/ground software/ hardware.

The T-X time ideally should be as close to T-0 as possible to reduce the risk of a safety event occurring that could result in the destruction of a possibly good vehicle after launch. The range user in asking for and accepting a T-X time, acknowledges awareness of, and acceptance of, the risk.

While it is the policy (and contractual requirement) of the LLV program to publish all procedures at least thirty days prior to their first use, the need to ensure that the latest information is incorporated holds the final release of the three launch documents until a week to 10 days prior to launch. All three documents are coordinated with, reviewed by, and approved by spacecraft and launch vehicle engineering, vehicle operations, range operations, and Range Safety.

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The personnel most involved in decision making during launch countdown include the following:

Range Personnel:

- Senior Mission Flight Control Officer (SMFCO)
- Mission Flight Control Officer (MFCO)
- Safety Technical Advisor (STA)
- Launch Decision Authority (LDA)
- Range Operations Commander (ROC)
- Range Control Officer (RCO)
- Launch Weather Officer (LWO)
- Operations Safety Manager (OSM)
- Complex Safety Officer (CSO)

Range User Personnel:

- User Launch Director (LD)
- Assistant Launch Director (ALD)
- Telemetry Systems Observer (TSO)
- Guidance Systems Observer (GSO)

Payload Personnel:

- Payload Operator (PLO)

The responsibilities of each during countdown operations are as follows.

SMFCO - The SMFCO is directly responsible to the 45th Launch Decision Authority for the safe conduct of a launch during countdown and flight operations. The 45 OG Commander and the 45 Vice Commander may also perform the LDA function as required. The LDA's, which may also includes the Wing Commander, undergo formal LDA training by 45 OGV. The SMFCO manages the flight control team during launch phase operations, maintains an overall view of range safety and vehicle prelaunch status, and directs the MFCO in critical operational decisions including countdown holds and flight termination.

MFCO - The MFCO is the focal point for the execution of safety policy, requirements, and procedures during all vehicle flight operations. He is responsible for controlling and coordinating the flight control portion of the countdown, and directs the actions of the mission flight control team. The MFCO does not do launch hazard assessment, he follows the established range safety guidelines. The MFCO with support of the Mission Flight Control team, safety support personnel (RANS, SES, SEO Analyst, Blast-Toxics (BTOX), OSM/RSR) and designated Range contractor personnel will provide a “MFCO GO” (with SMFCO concurrence) for launch to the LDA. The MFCO’s GO indicates to the LDA that to the best of the MFCO’s knowledge, all safety criteria are met and the launch may proceed into the flight phase.

STA – Safety Technical Advisor is a member of the 45 Wing Safety staff that provides technical support to the Chief of Wing Safety and/or the Launch Decision Authority (LDA) during launch operations. The STA for a launch mission is the Senior Safety technical representative assigned for that operation. The STA is not an individual but, like the MFCO, one of several qualified personnel selected from Wing Safety to support a particular mission.

LDA – The LDA serves as the final authority for launch decisions and performs the final polling in preparation for granting approval for launch. This position is usually manned by the Wing Commander, however, other Air Force staff such as the Vice Commander and Operations Group Commander may serve in this position.

<u>ROC</u> - The ROC is the senior range representative for launch operations. He serves as the interface between the launch agency and the range, and manages, directs, and controls range resources to ensure all range instrumentation is capable and ready to support launch operations. He is responsible for range support during the generation and launch phase of operations, including range instrumentation support, contingency support requirements, aircraft/marine vessel support, and support by off-range assets. He certifies range readiness and provides the launching agency the final overall range GO/NO-GO recommendation.

<u>RCO</u> - The RCO is responsible for the management of all operational range instrumentation. He directs all range system interfaces with user systems and coordinates with range system controllers to ensure mission-capable support during range operations. He reports status and GO/NO-GO recommendations to the ROC.

<u>OSM</u> - The OSM is responsible for all flight safety hardware on the launch vehicle. This includes the FTS receivers and the C-Band transponder. He is responsible for verifying the operation of the FTS. He resides at a console position in the LLV Launch Van, monitors arming of the FTS, and, with approval of the MFCO, enables or disables continuation of the countdown via the enable switch. He has a CRT screen with FTS specific telemetry to determine that status. He also has access to other telemetry data in order to monitor various other components of the vehicle. Upon the OSM’s receiving of a GO from the MFCO during terminal countdown, it is implied that the OSM and the CSO are also GO. During terminal countdown, all actions involving the OSM and CSO must be approved by the MFCO. The OSM and CSO are not “mission ready” certified positions and therefore cannot be responsible for GO/NO-GO decisions; however, the OSM and CSO may be polled independently.

CSO - The CSO is responsible for site safety at the launch complex and reports site status as appropriate. He has the ability to control site aural/visual warning devices and pad video. He assures that the pad is clear for launch via video monitors, and is assisted by the Complex Safety Technician who participates and monitors the vehicle arming operations. On launch day, the CSO resides at a console position in the Launch Van, and is responsible for all safety aspects of the launch complex, including pad clearing and re-entry.

LWO - The LWO is responsible for providing the latest weather information to the launch team. He is available for weather briefings at any time during countdown.

LD - The Launch Director (LD) is the range user's single point-of-command authority overseeing the launch team functions and responsibilities. He has the authority to stop the countdown at any point in the process, and is responsible for issuing final launch authorization. He ensures overall control of the countdown, maintains team discipline, and provides coordinating direction to the launch team during emergencies/contingencies, scrubs/recycles, and post-launch activities. Has final signature approval of all changes to the launch countdown procedure. He resides at the LLV Launch Van console position OPS 1, has authority over all testing activities, and works with Range Safety and the user system safety engineer to ensure safety during launch/test activities.

ALD - The ALD assists the LD in coordinating the activities in the Launch Van during launch countdown. He is capable of performing the functions and responsibilities of the LD should the need arise, and resides in the LLV Launch Van at console position OPS 2.

TSO - The Telemetry Systems Observer resides in the Launch Van.

GSO - Guidance/Navigation Systems Observer resides in the Launch Van at the telemetry ground station.

PLD1 - PLD1 is the payload manager who resides in the Launch Van and monitors the payload telemetry prior to launch to ensure the payload is ready to launch. He must rely on upper management and the Customer for decision to approve readiness of the payload. Once approval is received, a GO/NO-GO decision is relayed to the LD.

PLD2 - PLD2 is the assistant payload manager who resides in the Launch Van.

#### 2.4.5.7.3 Inflight Operations

After vehicle ignition, the MFCO receives an "ignition" and "lift-off" call from the Vertical Wire Skyscreen Officer followed by a status report from the Telemetry Systems Officer. The Vertical Plane indicator is the first display item to generate history and appear to move, followed by the Instantaneous Impact Predictor. All MFCOs report on a common voice net with a continuing dialogue as flight proceeds downrange and display maps change automatically. The Wire Skyscreen operator will report any abnormalities and staging events, if observed. The TM will report vehicle performance and events as displayed on the Range Safety Telemetry Display System. Any malfunctions or trajectory divergences observed by one MFCO will be confirmed by another MFCO.

The Command Systems Officer monitors command carrier switching for the flight termination system as the vehicle proceeds downrange and below the horizon to the CCAS command site. The CMEV's in the CCRS use plus time and elevation data for each command station to determine automatically which station should be radiating the command carrier.

## 2.4.6 Personnel Training and Certification

This section addresses the training and certification of mission essential personnel: those personnel who are critical to the Range Safety function.

#### 2.4.6.1 MFCO Training

The Mission Flight Control Officer may be a member of the Range Squadron within the 45th Operations Group, or of 45 SW/SEOO. The MFCO is the official representative of the Wing Commander and is responsible for taking all reasonable precautions to minimize the risk to life and property during a launch vehicle's flight.

Initially, each potential MFCO undergoes supervised training and checkout in assigned launch vehicle flight control support positions. These positions include Vertical Wire Skyscreen, Telemetry, Command MFCO, Forward Observer, and Surveillance Control Officer. The trainee observes, participates, and is formally checked out in each position during actual launches. In addition, he is trained as a primary MFCO in simulated launch exercises where failures in the vehicle's flight, instrumentation and communications are simulated. These exercises are not only designed to familiarize the trainee with potential problems and solutions, but are also used to gauge his judgment, reaction time, and stability under stressful conditions.

The trainee becomes familiar with the range, its instrumentation, facilities, and personnel through conducted tours and briefings. He is assigned a launch vehicle program and becomes familiar with all aspects of its functions, systems, and operational characteristics.

The trainee is checked out as a primary MFCO only after satisfactorily completing all initial phases of the training program. The 45 SW/SEOO, Mission Flight Control personnel observe the training and certification process and provide a coordination function on certification packages for prospective MFCO's. Final checkout consists of manning the MFCO console during an actual launch vehicle launch as the Wing Commander's official representative, responsible for terminating a launch vehicle flight if established safety criteria are violated. The MFCO continues to increase in experience and knowledge by assisting other primary MFCOs during their launches and training exercises, and by undergoing recurring MFCO training as necessary.

After the MFCO trainee has successfully completed training, he and the Training Officer meet with the Operations Group Commander to review and evaluate the trainee and his records. The Operations Group Commander will, after conducting this review, recommend to the 45 Wing Commander that the trainee be certified as an MFCO, or advise the Training Officer that additional training is required.

#### 2.4.6.2 Launch Vehicle Flight Analysis Training

No formal training plan currently exists for new flight analysts coming into the Flight Control and Analysis Section. All personnel are degreed mathematicians or scientific analysts. On-the-job training is the primary method used for flight analysis personnel. The trainee is assigned a specific vehicle program and receives guidance and instructions from a senior analyst who reviews and approves the trainee's work. The trainee performs analyses of vehicle performance, failure modes, spent stage impact debris, impact limit lines, destruct lines, and many other safety related issues. These analyses help to assure that the proposed space vehicle missions are being conducted in a manner consistent with flight safety criteria.

#### 2.4.6.3 Launch Vehicle System Safety Training

All personnel in the Systems Safety Section are subject to training requirements dictated by their position descriptions. Training is accomplished in a variety of different ways, ranging from individual self-study courses and technical seminars and symposiums, to diverse college-level courses presented by many universities and colleges across the country. Section resources play a significant role in the overall training program.

A formal training plan has been established and has been in force within the System Safety Section for many years. The initial training phase covers approximately 52 weeks for a safety engineer entering at the GS-07 level. Training is provided by designated subject matter specialists (within or outside of the System Safety Section) or at government training facilities. The trainee is required to attend and satisfactorily complete formal academic programs at the undergraduate and/or graduate level. On-the-job training is a very important part of the training process. Areas that the trainee is exposed to include the following: pad safety, facilities, governing safety directives, explosives safety, flight termination systems, nuclear safety, solid/liquid propellants, toxic hazards, hypergolics, launch vehicles, downrange stations, industrial safety, ground safety, and payload safety.

#### 2.4.6.4 Other Training

In addition to the above training requirements, there are a number of other critical areas that also must meet stringent training criteria. For example, the Operations Safety Manager must undergo a rigid training program. He is the MFCO's on-scene representative, verifying that all aspects of the destruct system tasks have been done in accordance with approved procedures. Similar training/certification requirements exist for instrumentation operators, radar personnel, the command destruct transmitter technicians, and a number of others.

### 2.4.7 Eastern Range Interfaces

Interfaces between Range Safety and other internal ER organizations are as follows:

#### 2.4.7.1 Commander, 45th Operations Group

The Commander, 45th Operations Group (45 OG) Commander is responsible for:

- Provide MFCO's through the 45 RANS/DOOC Mission Flight Control Flight in support of launch operations. MFCO's execute the flight safety program under the auspices of Range Safety (45 SW/SE Wing Safety). See Figure 2-16
- Complying with, implementing, and enforcing the Range Safety Program.
- Reviewing and accepting all prelaunch and launch operations procedures at CCAS for Air Force Programs, including hazardous and safety critical procedures that may affect public safety or launch area safety, after insuring they have been approved by Range Safety.
- As a control authority, in accordance with the Range Safety Training and Certification Plan, reviewing, approving, and accepting prelaunch and launch operations procedures for Air Force programs that are limited to launch complex safety concerns.

Providing Range Safety with the instrumentation, computers, communications, command transmitter systems, and Range Safety display systems necessary to carry out prelaunch and flight safety functions. Range Safety provides the 45 OG with mandatory required support, the 45 OG ensures that these requirements are met.

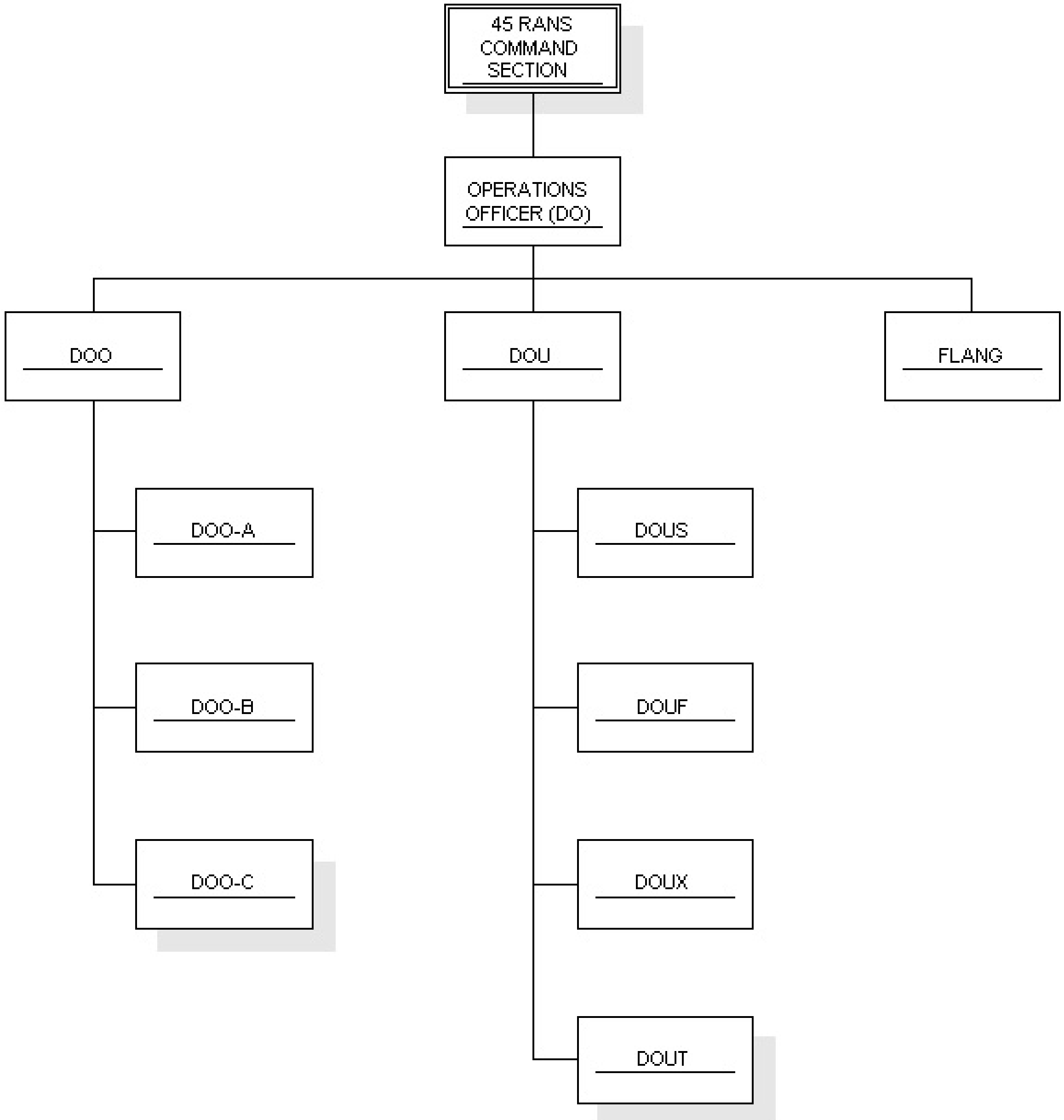


**Figure 2 - 16: 45 RANS ORGANIZATION**

#### 2.4.7.2 Commander, 45th Logistics Group

The Commander, 45th Logistics Group (45 LG) Commander ensures that all required instrumentation, computers, communications, command systems, and Range Safety display systems necessary for Range Safety to carry out its functions meet Range Safety requirements, perform to the prescribed level of reliability, and are designed in accordance with Range Safety specifications and requirements.

#### 2.4.7.3 Commander, 45th Medical Group

The Commander, 45th Medical Group (45 MED GP) Commander is responsible for determining, coordinating, and enforcing medical, biological, and radiological health requirements. The Radiation Protection Officer and Bioenvironmental Engineering are responsible for establishing and implementing their programs in coordination with the Safety Office (45 SW/SE).

#### 2.4.7.4 Other

The appropriate ER agencies provide computational, plotting, and reproduction services for flight control planning and preflight requirements as follows.

- Operate computing and plotting equipment at the Central Computer Complex and Technical Laboratory Computer Facility.
- Perform analytical studies, formulate mathematical models, and develop computer programs to meet specifications established by SEO.
- Maintain, document, and operate the computer programs listed in the current Semiannual Computer Program Survey document.
- Process magnetic tapes and provide computer listings and trajectory output files.
- Compute random and systematic errors for the instrumentation systems used for flight control. Errors must be converted to appropriate statistical parameters to evaluate the magnitude of real-time impact predictor errors throughout thrusting flight.
- Calculate acquisition times, look angles, aspect angle, and signal strengths to arrive at tracking, telemetry, and command destruct expected coverage estimates.
- Maintain the real-time impact prediction program and other related real-time and prelaunch programs. Evaluate time delays in the real-time program and in associated instrumentation systems.
- Provide miscellaneous reproduction and photographic services and prepare viewgraphs and briefing slides as required.

### 2.4.8 Range User Responsibilities and Requirements

The range users have the responsibility to provide safe systems, equipment, and facilities and to conduct their operations in a safe manner that complies with and implements those portions of the ER safety program that are applicable to their program. This is accomplished by joint Range Safety/range user review and approval of components, systems, and subsystems at design reviews; the approval of hazardous operations and their associated operational procedures; the acceptance and qualification tests for critical systems, such as the FTS; the review and approval of quantity-distance siting for all support facilities and launch complexes; and the data required for flight plan approval.

### 2.4.9 Computer Programs

Computer programs used by Range Safety and support organizations are listed in the Appendix with a brief discussion on each.

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14. AFI 32-9003 “Granting Temporary Use of real Property”
15. AFMAN 91-201 “Explosive Safety Standards”
16. DoD 6055.9-STD “DoD Ammunition and Explosive Safety Standard”
17. DoDD 3200.11 “Major Range and Test Base Facility”
18. DoDD 3230.3 “DoD Support for Commercial Space Activities”
19. FAA/AST 14 CFR, Chapter III, “Commercial Space Transportation: Licensing Process for Commercial Space launch Activities”
20. Public Law 60, 81st Congress, 1st session, “Guided Missiles Joint Long Range Proving Ground”
21. Public Law 91-190 “National Environmental Policy Act”
22. Public law 98-575, 49 USC 2601-2623 “The Commercial Space Launch Act”

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# APPENDIX A

The following list of computer programs are used by the 45th SW Range Safety and supporting organizations:

| PROGRAM | Computer /User | USAGE | Description |
|---|---|---|---|
| COLA Collision Avoidance Program | Cyber/SEY & RTS (CCAS) Contr. | Pre Operation | Computes closest approach of launch vehicle and orbiting object. |
| DFPC Debris Footprint Processor Console | DEC 212LP PC/RTS (CCAS) Contr. | Realtime | Displays DFPH-generated graphics data acting as the operator's console. |
| DFPH Debris Footprint Processor Host | VAX 3900/RTS (CCAS) Contr. | Realtime | Generates graphics footprint Displays in accordance with Information received from DFPC and DFPI. |
| DFPI Debris Footprint Integrator | 12 DECstation 3100s/RTS (CCAS) Contr. | Realtime | The DFPI system consists of 12 DECstation 3100s with one processor acting for each of ten possible pieces to be processed. An eleventh processor acts as the hull generator and a twelfth Processor is available as a hot spare. |
| DRSD Distributive Range Safety Displays | FEP 80486 and Display DECstation 5000/RTS (CCAS) Contr. | Realtime Backup Launch Support | Backup realtime system used to monitor the flight of vehicles launched from CCAS. |
| FPTP Footprint Pre-Test Program | Cyber/RTS (CCAS) Contr. | Pre-Operation | Collects debris piece parameters, atmosphere and wind data, and key piece specific data and prepares a file for the realtime footprint program. |
| FUDZ Footprint Users Display on the Zenith PC | Zenith 150 PC/RTS (CCAS) Contr. | Realtime | Controls footprint display Output from cyber program RCCF. |

| PROGRAM | Computer /User | USAGE | Description |
|---|---|---|---|
| GDIGTP5 Geodetic Translation | Cyber/SEY | Analysis | Performs various coordinate system conversions, (Procedure is +,IGTP) |
| LARA Version 20 Launch Risk Analysis | Cyber/SEY | Analysis | Launch area mission risk Analysis and related Programs. |
| PREX Preparation of VAX Backgrounds | Cyber/RTS (CCAS) Contr. | Pre-Operation | Assembles information Specified in the Range Safety requirements letter and generates a file that is used to produce the Range Safety display background. |
| PROX Preparation of VAX Background Verification | Cyber/RTS (CCAS) Contr. | Pre-Operation | Assemblies' information specified in the Range Safety verification letter and generates an output to use at the VAZ computer. |
| RAID Realtime Acquisition and Impact Display | Cyber/RTS (CCAS) Contr. | Realtime single vehicle support | Used at CCAS to support all single launch vehicles. Sends information to the Range Safety displays. |
| RCCF Realtime Continuous and Catastrophic Footprint | Cyber/RTS (CCAS) Contr. | Realtime Footprint | Operates under the RAID program to provide realtime footprint support. |
| RFFT3 Range Safety Free Flight Trajectory & Impact Point | Cyber/SEY | Analysis | Generates a free flight trajectory. (Procedure is +,RFFT) |
| RIPP3 Range Safety Impact Point & Destruct Line plot | Cyber/SEY | Analysis | Produces Calcomp plots of maps, trajectories, destruct lines, critical events, etc. (Procedure is +,RIPP) |

| PROGRAM | Computer /User | USAGE | Description |
|---|---|---|---|
| RLAN5 Range Safety Look Angle Program | Cyber/SEY | Analysis | Computes azimuth, elevation And range (look angles) from a ground location to a trajectory. (Procedure is +,RLAN) |
| RSAC2 Range Safety Angle Combining | Cyber/RTS (CCAS) Contr. | Pre-Operation | Produces an output that contains the most critical destruct criteria grid from up to 3 RSCA cases. |
| RSAT Range Safety Atmosphere Model Program | Cyber/RTS (CCAS) Contr. | Atmos. | Generates a series of overlapping continuous cubic polynomial fits to represent large quantities of data points. Provides optional plotting on the Calcomp plotter. |
| RSCA6 Range Safety Critical Angles | Cyber/RTS (CCAS) Contr. | Pre-Operation | Generates a two-dimensional field of critical angles for various vehicle pieces with respect to time. |
| RSCD5 Range Safety Chevron Destruct Lines | Cyber/RTS (TLCS) Contr. | Pre-Operation | Produces Calcomp plots and files of close-in impact predictor (Chevron) destruct lines. |
| RSCP6 Range Safety Critical Planes | Cyber/RTS (CCAS) Contr. | Pre-Operation | Produces vertical plane plots on the Calcomp plotter. |
| RSDL5 Range Safety Destruct Line Program | Cyber/RTS (CCAS) Contr. | Pre-Operation | Calculates the impact Predictor destruct criteria. Also, is used in generating footprint background information. |
| RSDP5 Range Safety Destruct Line Plotter | Cyber/RTS (CCAS) Contr. | Pre-Operation | Uses RSDL output file to generate impact templates in envelope form. |

| PROGRAM | Computer /User | USAGE | Description |
|---|---|---|---|
| RSEE9 Range Safety Error Ellipse | Cyber/RTS (CCAS) Contr. | Analysis | Computes impact error ellipses from single stations or trilateral stations tracking input. |
| RSGC1 Range Safety Gravity Corrected Reduced Velocities | Cyber/SEY | Analysis | Computes no-turn failure Mode position data. Removes gravity term from range user trajectories. (Procedure is +,RSGC) |
| RSGNO Range Safety Green Number | Cyber/SEY | Pre-Operation | Computes green numbers for Range Safety displays. (Procedure is +,RSGNO) |
| RSIP6 Range Safety Impact Predictor | Cyber/SEY & RTS (CCAS & TLCS) Contr. | Analysis | Computes predicted impact positions of vehicles or Pieces. |
| RSIT RSTS Interpolation | Cyber/SEY | Analysis | Interpolation for output from RSTS. |
| RSKP4 Range Safety Dispersion Envelope | Cyber/RTS (CCAS) Contr. | Analysis | Computes impact points of a launch vehicle if all control were lost at specified time to yield an estimate of the dispersion envelope. |
| RSKR1 Range Safety Chart Boundaries | Cyber/SEY | Analysis | Computes the Range Safety display boundaries in latitude and longitude. (Procedure is +,RSKR or +,PROCKR) |
| RSMR7 Range Safety Maximum Range | Cyber/RTS (CCAS) Contr. | Analysis | Computes maximum pad-to-impact range for a launch vehicle given an initial slant range and scalar velocity. |
| RSPC5 Range Safety Probability Contour | Cyber/RTS (CCAS) Contr. | Analysis | Calculates the rectangular or geodetic coordinates defining a specified contour, and generates a Calcomp file, regarding probability that impact pieces will hit an object-of-concern. |

| PROGRAM | Computer /User | USAGE | Description |
|---|---|---|---|
| RSPF1 Range Safety Powered Flight & Turns | Cyber/RTS (CCAS) Contr. | Analysis | Produces a family of Malfunctioning trajectories. Output files are used for Programs RSTS and RSIP. |
| RSRB5 Range Safety Range & Bearing Program | Cyber/SEY | Analysis | Computes range and bearing Between two points, direct Solution, or geodesic. (Procedure is +,RSRB) |
| RSSP2 Range Safety Ship Hit Probability Program | Cyber/RTS (TLCS) Contr. | Pre-Operation | Computes the probability of a Boat or ship located in the Launch area being hit by Vehicle debris. Also Generates a Calcomp plot. |
| RSTC3 Range Safety Trajectory Critical Angles | Cyber/SEY & RTS (CCAS) Contr. | Analysis | Using RSCA or RSAC input Files, produces critical angles From a Range Safety Trajectory file. (Procedure is +,RSTC) |
| RSTS6 Range Safety Template Sorting | Cyber/RTS (CCAS) Contr. | Pre-Operation | Sorts, merges and generates Calcomp plots of chevron Destruct line data from files Produced by RSPF and RSIP. |
| RSTT3 Range Safety Tumble Trajectory | Cyber/SEY | Pre-Operation | Produces a tumble trajectory. |
| RSTX1 Range Safety Training Exercise | Cyber/SEY | Range Safety Training | Computes deviant present Position trajectories (left or right turns, pitch-up or pitch-down, or combinations of turn and pitch) from a Nominal trajectory to use for OD-16 exercises. (Procedure is +,OD16) |
| RSVF4 Range Safety Verify Program | Cyber/SEY | Verify Range Safety displays | Produces card image file for Input to the PROX or TROX Program. (Procedure is +,RSVF) |

| PROGRAM | Computer /User | USAGE | Description |
|---|---|---|---|
| RSV12 Range Safety Variable Interpolation | Cyber/SEY | Analysis | Performs linear and non-Linear interpolation. (Procedure is +,RSVI) |
| RSWC3 Range Safety Wind Check | Cyber/RTS (CCAS) Contr. | Pre-Operation | Computes the amount by Which the impact point drifts From the impact limit line Given a wind profile. |
| RSZC Range Safety Requirements Letter | Cyber/SEY | Pre-Operation | Generates standardized letter for the CCC. (Procedure is +,RSZC) |
| RTAR4 Range Safety Translation & Rotation | Cyber/SEY | Analysis | Translates, rotates and scales Position and velocity data From one fixed location on the earth's surface to another. (Procedure is +,RTAR) |
| RTRC4 Range Safety Translation & Rotation Scale Calculation | Cyber/SEY | Analysis | Computes the translation and Rotation scale calculations for Any given trajectory. (Procedure is +,RTRC) |
| RTRP4 Range Safety Translation & Rotation Plotting | Cyber/SEY | Analysis | Generates plots of a pad-referenced trajectory in a site-referenced system. (Procedure is +,RTRP) |
| RVIP3 Range Safety Vacuum Impact Prediction | Cyber/SEY | Analysis | Calculates vacuum impact Prediction points (latitude And longitude) for a Trajectory. (Procedure is +,RVIP) |
| RVPT4 Range Safety Vertical Plane Plot | Cyber/SEY | Analysis | Creates plot of vertical plane Trajectories. (Procedure is +,RVPT) |

| PROGRAM | Computer /User | USAGE | Description |
|---|---|---|---|
| TAIL Trident Acquisition & Impact Location | Cyber/RTS (CCAS) Contr. | Realtime Multi-Vehicle Launch Support | Supports up to four near-Simultaneous Trident Launches in realtime. Data is Sent to the Range Safety Displays. |
| THEO Theoretical Tape Generator | Cyber/RTS (CCAS) Contr. | Pre-Operation | Simulates realtime raw data as it would originate from any instrumentation site selected. |
| TROX Multi-Vehicle Background Verification | Cyber/RTS (CCAS) Contr. | Verify Range Safety displays | Assembles information Specified in the Range Safety Verification letter and Generates a file that is used to Verify the Range Safety Multi-Vehicle display background Information. |
| TTUD Titan Trajectory Update Delta | Cyber/RTS (CCAS) Contr. | Realtime Launch Support | Copies a file containing time and delta position values during the countdown. Subsequently uses the file to update nominal Range Safety displays of VP and IP for launch day winds. |
| VODS VAX Multi-Vehicle Display System | VAX/RTS (CCAS) Contr. | Realtime Launch Support | Places information received From the TAIL program on the Range Safety displays. |
| VXDS VAX Display System | VAX/RTS (CCAS) Contr. | Realtime Launch Support | Places information received From the RAID program on the Range Safety displays. |
| VVDS VAX Verification | VAX/RTS (CCAS) Contr. | Verify Range Safety displays | Loads display files created by VXPT and activates them via Keyset selected. |
| VXPT VAX Pre-Test Program | VAX/RTS (CCAS) Contr. | Pre-Operation | Generates the Range Safety Display backgrounds from the Input generated by the PREX Program. |

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